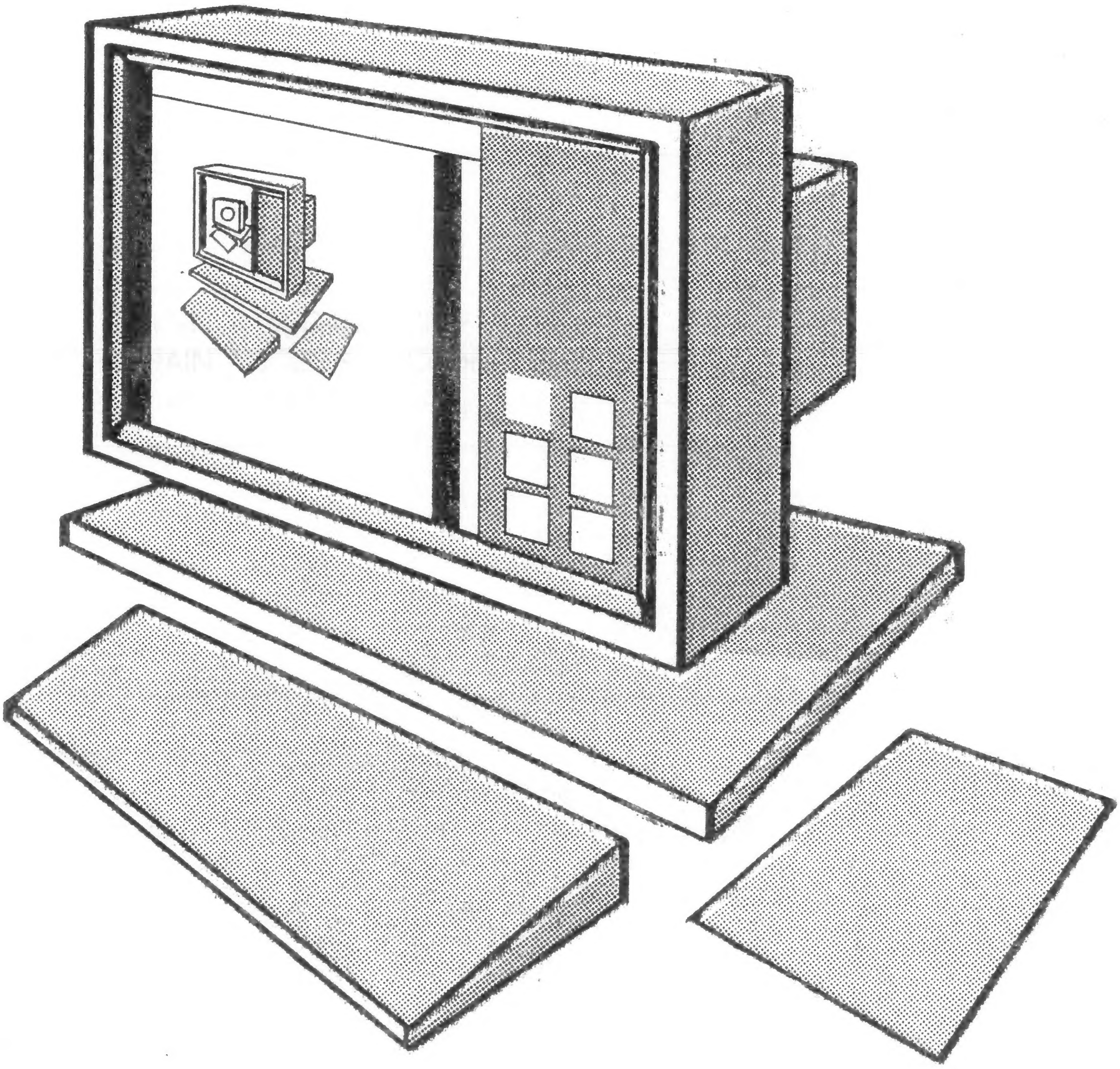
DOC: COM I
REV: 2.1

COMMUNICATIONS I

APOLLO EDUCATIONAL SERVICES



DATA COMMUNICATIONS

GENERAL COMMUNICATIONS

Introduction
Data transmission basics
RS232-C serial port communications -
Modem operation, Tctl, Siorf/Siotf, Emt, Siologin,Siomonit
Practical exercise

PCI -1

Domain to IBM PC connection
Software,hardware requirements
Software installation and operation
Practical exercise

ETHERNET

General operation
Specifications and configuration guidelines for standard and thin wire

NATIVE ETHERNET + DOMAIN INTERNETS / BRIDGE PRODUCTS

Practical exercise

INTRODUCTION TO TCP-IP COMMUNICATIONS -

DOMAIN TCP/IP
DOMAIN/IX BSD4.2 TCP/IP
DOMAIN ACCESS (Communications with VAX/VMS)
Internet concept, TCP/IP configuration
Creating the TCP/IP enviroment
Practical exercise

NFS

Introduction to NFS on APOLLO
Configuration,Software installation and operation.
Practical exercise

X25

Introduction to X25
Configuration/British Telecom requirements
Software installation and operation

MODULE 1

GENERAL COMMUNICATIONS

AGENDA

a, HISTORY OF DATA COMMUNICATIONS

b, DATA TRANSMISSION BASICS

c, RS232-C SERIAL PORT COMMUNICATIONS
   - Modem usage
   - Tctl
   - Siotf,Siorf
   - Emt
   - Siologin,Siomonit

d, LAB 1

HISTORY OF DATA COMMUNICATIONS

In the begining there was Morse code .

A .-	K -.-	U ..-	3 ...--
B -...	L .-..	V ...-	4 ....-
C -.-.	M --	W .--	5 .....
D -..	N -.	X -..-	6 -....
E .	0 ---	Y -.--	7 --...
F ..-.	P .--.	Z --..	8 ---..
G --.	Q --.-	, --..--	9 ----.
H	R .-.	. .-.-.-	0 -----
I ..	S ...	1 .----	
J .---	T -	2 ..---	

Baudot Code was later introduced as a more suitable representation of characters for use in early Telegraphy.

Morse and Baudot codes were not really suitable for machines hence the following binary codes are used for character representation by computers today :

ASCII (ANSI standard X3.4 – 1977)

EBCDIC (IBM)

HEX-ASCII CONVERSION CHART

Bit Positions: 4	3	2	1	7: 0 6: 0 5: 0	0 0 1	0 1 0	0 1 1	1 0 0	1 0 1	1 1 0	1 1 1
0	0	0	0	NUL	DLE	SP	0	@	P	`	p
0	0	0	1	SOH	DC1	!	1	A	Q	a	q
0	0	1	0	STX	DC2	"	2	B	R	b	r
0	0	1	1	ETX	DC3	#	3	C	S	c	s
0	1	0	0	EOT	DC4	$	4	D	T	d	t
0	1	0	1	ENQ	NAK	%	5	E	U	e	u
0	1	1	0	ACK	SYN	&	6	F	V	f	v
0	1	1	1	BEL	ETB	'	7	G	W	g	w
1	0	0	0	BS	CAN	(	8	H	X	h	x
1	0	0	1	HT	EM	)	9	I	Y	i	y
1	0	1	0	LF	SUB	*	:	J	Z	j	z
1	0	1	1	VT	ESC	+	:	K	[	k	{
1	1	0	0	FF	FS	,	<	L		l	|
1	1	0	1	CR	GS	–	=	M	]	m	}
1	1	1	0	SO	RS	.	>	N	Λ	n	~
1	1	1	1	SI	US	/	?	O	—	o	DEL

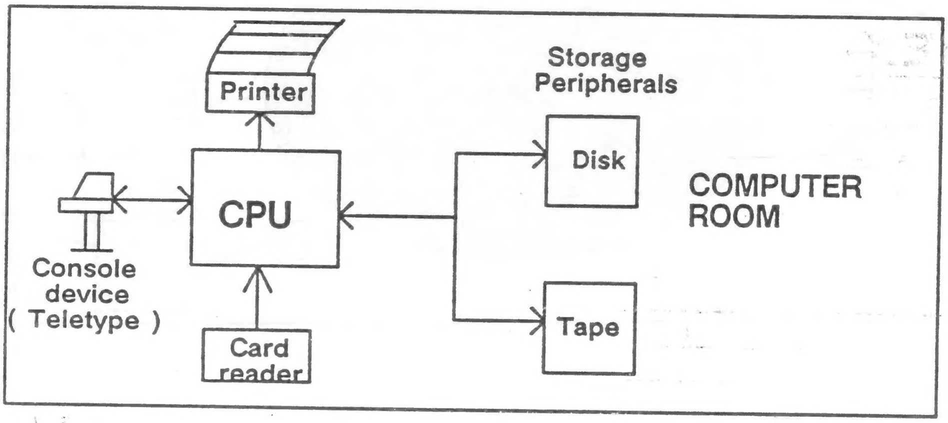
HEX-EBCDIC CONVERSION CHART

1st HEX DIGIT \ 2nd HEX DIGIT	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	NUL	SOH	STX	ETX	PF	HT	LC	DEL		RLF	SMM	VT	FF	CR	SO	SI
1	DLE	DC1	DC2	DC3	RES	NL	BS	IL	CAN	EM	CC		IFS	IGS	IRS	IUS
2	DS	SOS	FS		BYP	LF	ETB	ESC			SM			ENQ	ACK	BEL
3			SYN		PN	RS	UC	EOT					DC4	NAK		SUB
4	SP										¢	.	<	(	+	|
5	&										!	$	*	)	;	¬
6	–	/									¦	,	%	_	>	?
7											:	#	@	'	=	"
8		a	b	c	d	e	f	g	h	i						
9		j	k	l	m	n	o	p	q	r						
A		~	s	t	u	v	w	x	y	z						
B																
C	{	A	B	C	D	E	F	G	H	I						
D	}	J	K	L	M	N	O	P	Q	R						
E	\		S	T	U	V	W	X	Y	Z						
F	0	1	2	3	4	5	6	7	8	9						

Data Communications in Computing

1950's :

- Little or no data communications.
- Input and output devices located in the same room
- Jobs processed one at a time
- Efficient use of CPU time but not of poeples time

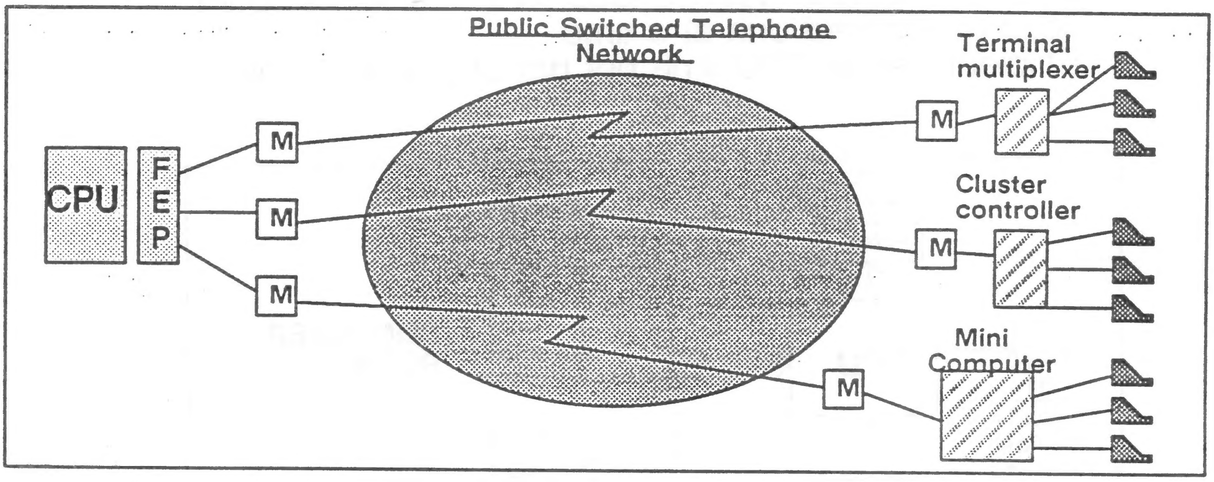


1960's :

- Batch processing using RJE.
- Orders could be entered, inventry checked on-line.

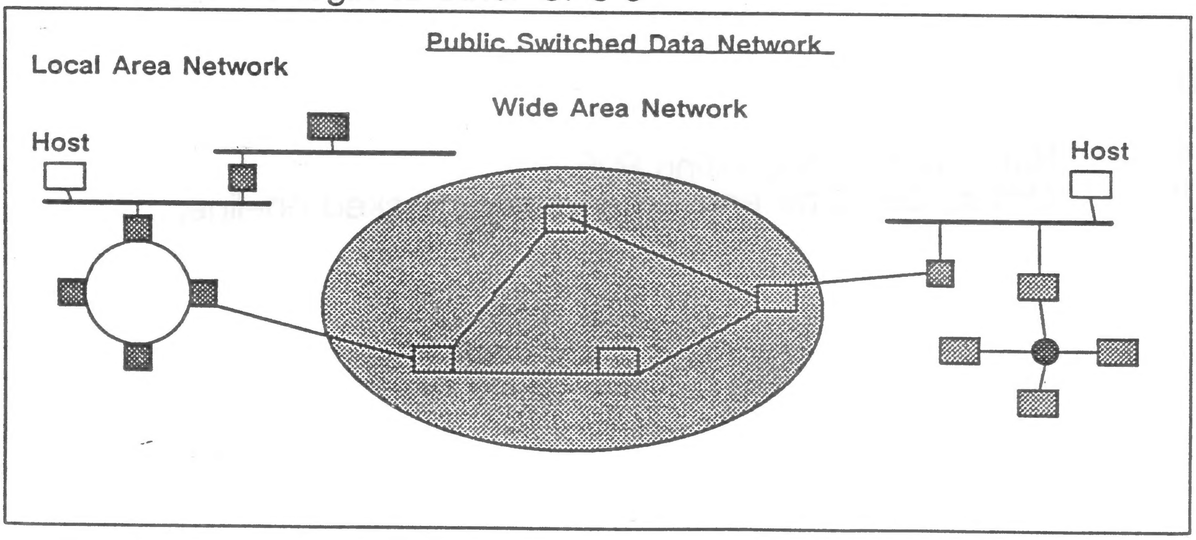
1970's :

- Batch
- Remote terminals
- Remote Minicomputers



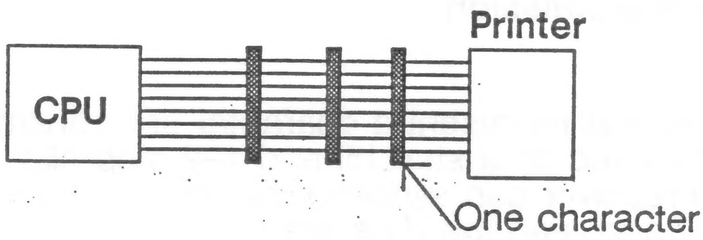
1980's :

- Distributed operating systems
- Heterogeneous and homogeneous enviroments
- CPU per user
- Local and remote transparent file access
- Remote login to other CPU's

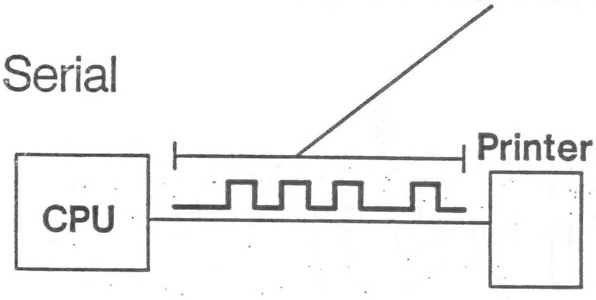


DATA TRANSMISSION BASICS

Parallel

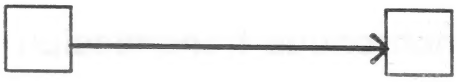


Serial

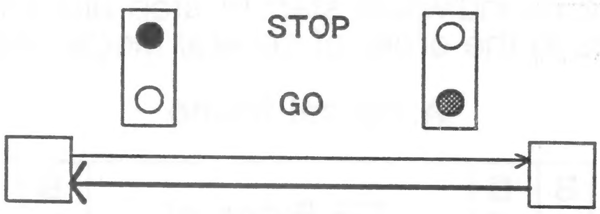


Communication modes

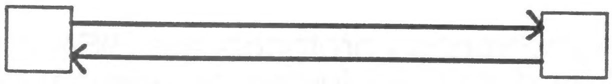
- Simplex



- Half Duplex



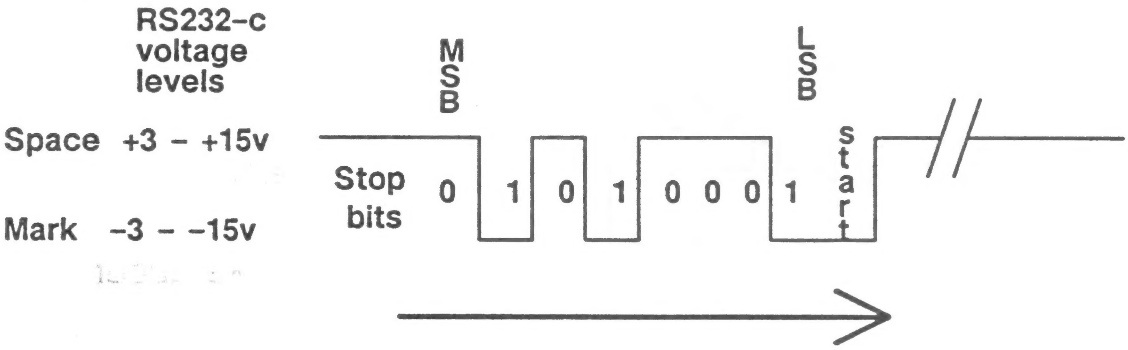
- Full Duplex



Transmission modes

■ Asynchronous transmission

The seven or eight data bits that represent a character are transmitted as a self contained unit, enclosed by a start bit and 1-2 stop bits. This is self clocking as the receiver can synchronize onto the start and stop bits in order to identify and read the data bits.

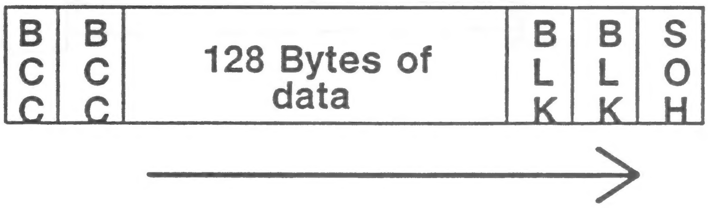


The necessity to detect start and stop bits determines the maximum reliable transfer rate of asynchronous transmission to be 19.2k Baud.

■ Synchronous transmission

Blocks of characters or bits are transmitted as a frame.Each frame also contains control and error information to ensure reliable transfer , but there are no individual start or stop bits.This enables much higher transfer rates in the order of several Mega bits per second to be used.

A typical frame



Common synchronous protocols are BISYNC, HDLC and SDLC. These will be discussed further as relevant products are covered.

Transmission rates

Baud rate

Is a measure of the number of signal elements transmitted down a line per second. ie

An asynchronous character is normally represented by **ten bits**, eight data, one start and one stop.

300 Baud would then give 30 characters per second
1200 Baud would give 120 characters per second etc.

The transfer of a one megabyte text file at 1200 Baud would take about 2 hours and 15 minutes.

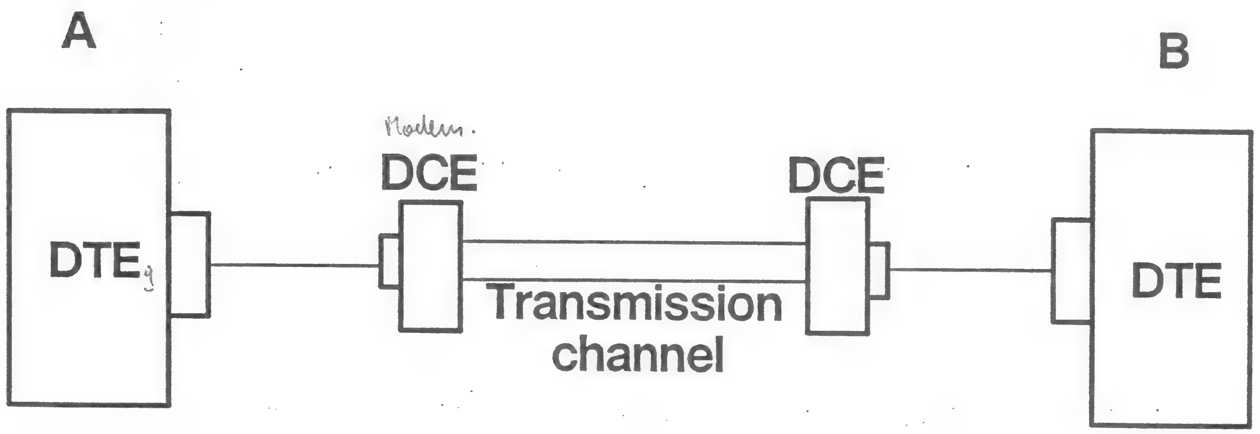
Bits per second

This is a measure of data bits per second and is normally the same as the Baud rate. However later transmission techniques enable one line signal element to represent more than one data bit, hence the data transfer rate (bps) would exceed the baud rate.

Other issues to be considered later in this module are :

1. **Error detection methods**
2. **Data flow control.**

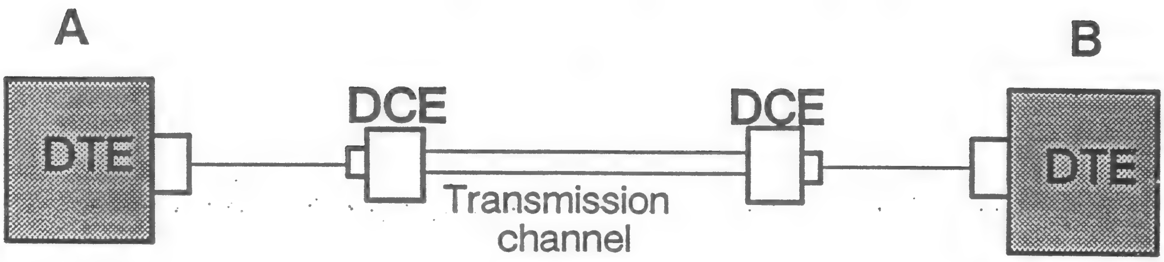
General description of a Data Communications system



The universal seven part data communications system:

1. The DTE at point A .
2. The interface between DTE and DCE.
3. The DCE.
4. The transmission medium.
5. The DCE at point B.
6. The DCE–DTE interface at point B.
7. The DTE at point B.

1 & 7 The Data Terminal equipment (DTE)



Can be a host computer, terminal, printer or some other device.

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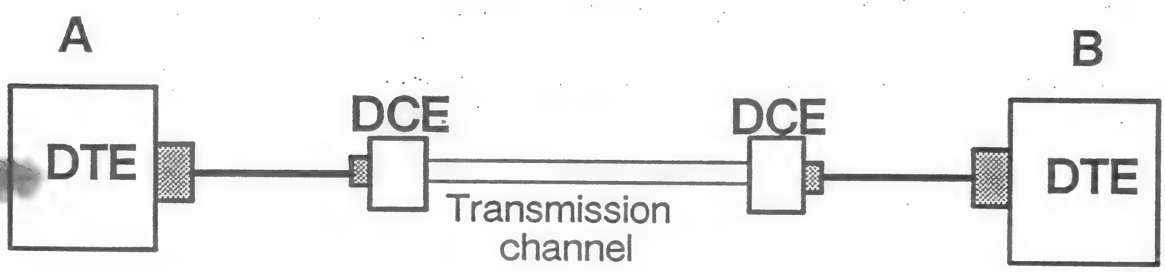
2 & 6 The interface



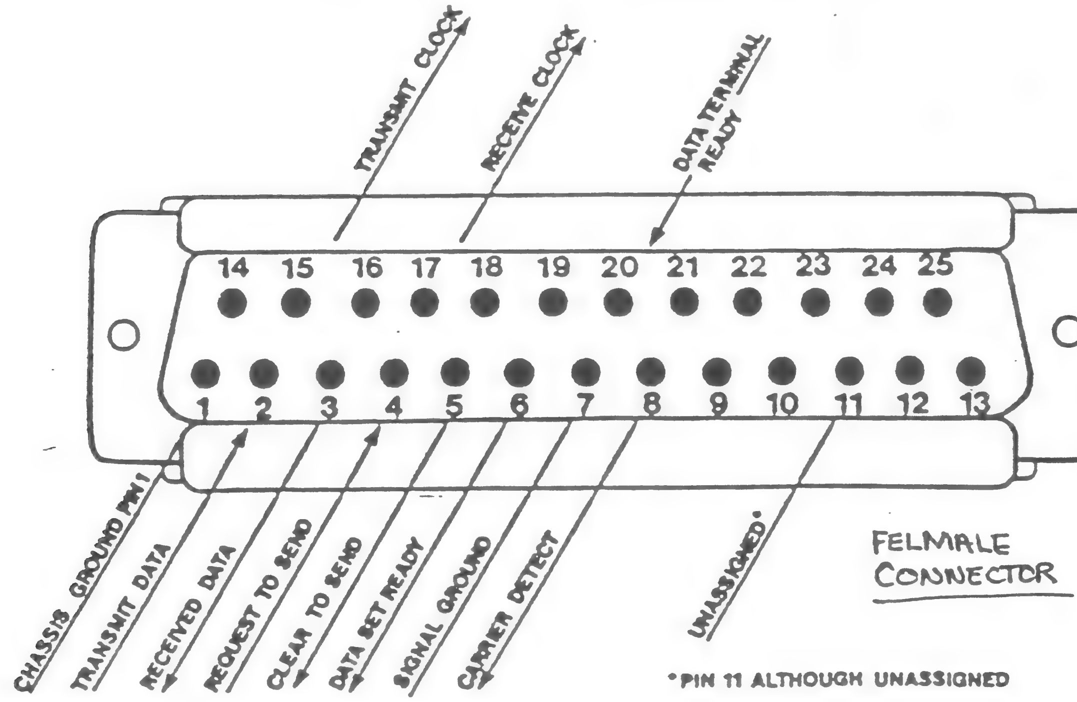
20 ma loop
60 ma loop
RS232–C, V.24
RS449, V.35
RS422, V.11
RS423
X.21
X.21–BIS (RS232–C)

The interface connects the DTE to the DCE and would normally conform to one of the above standards.

EIA RS-232-C PIN ASSIGNMENTS

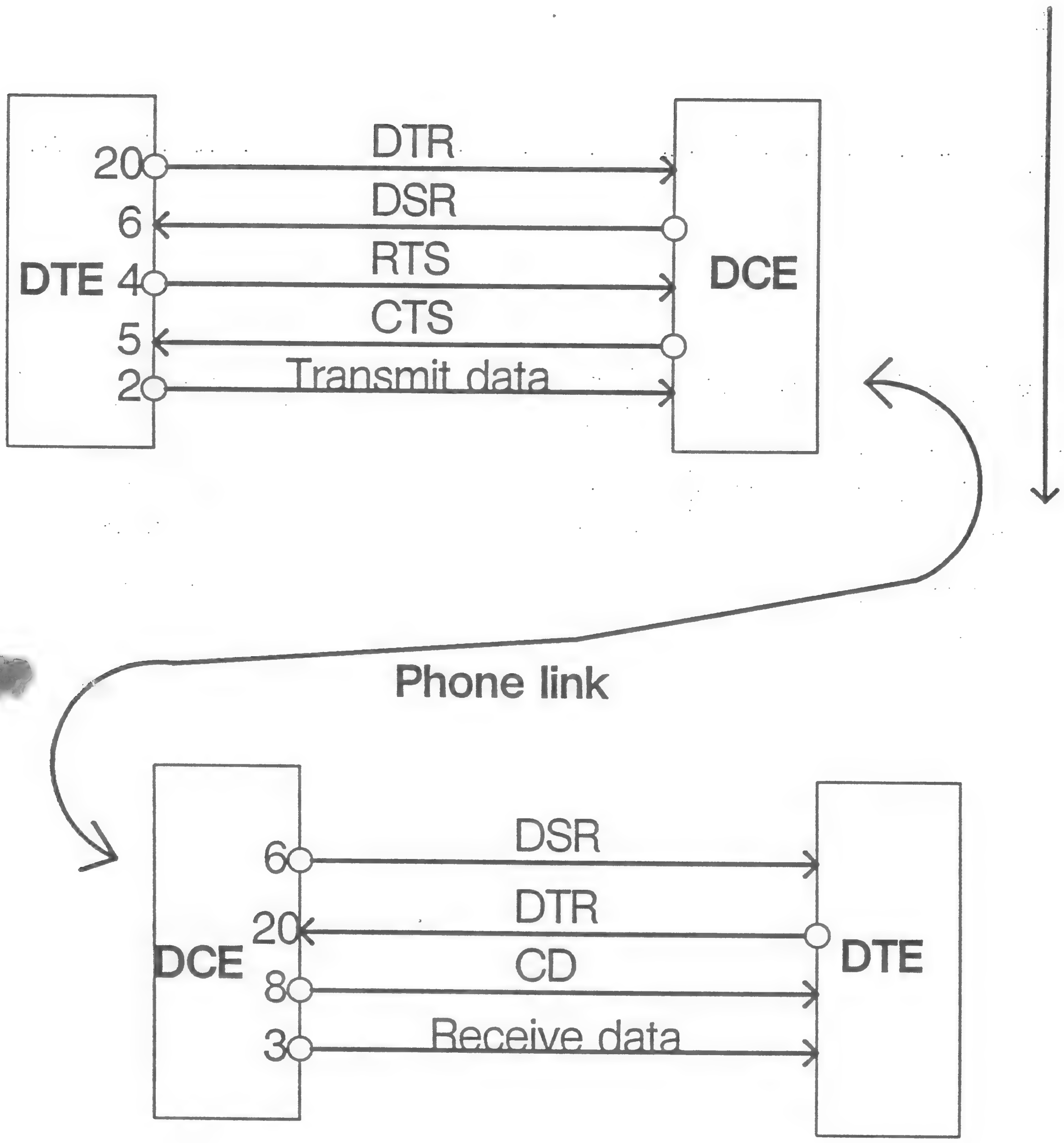
PIN	EIA	ABBREV.	SIGNAL DESCRIPTION	SOURCE
1	AA		Frame Ground	
2	BA	TX or TD	Transmit Data	DTE
3	BB	RX or RD	Received data	DCE
4	CA	RTS	Request to Send	DTE
5	CB	CTS	Clear to Send	DCE
6	CC	DSR	Data Set Ready	DCE
7	AB		Signal Ground	
8	CF	CD	Carrier Detect	DCE
9			(test)	
10			(test)	
11			(unassigned)	
12	SCF		Secondary Carrier Detect	DCE
13	SCB		Secondary Clear to Send	DCE
14	SBA		Secondary Transmit data	DTE
15	DB	SCT	Transmit Timing (Clock)	DCE
16	SBB		Sec. Recieved data	DCE
17	DD	SCR	Rec. Timing (clock)	DCE
18			(unassigned)	
19	SCA		Sec. Request to Send	DTE
20	CD	DTR	Data Terminal Ready	DTE
21	CG		Signal Quality Detector	DCE
22	CE	RI	Ring Indicator	DCE
23	CH/CI		Data Sig. rate selector	DTE
24	DA		Trans. Timing (Clock)	DTE
25			(unassigned)	

RS-232-C PIN ASSIGNMENTS

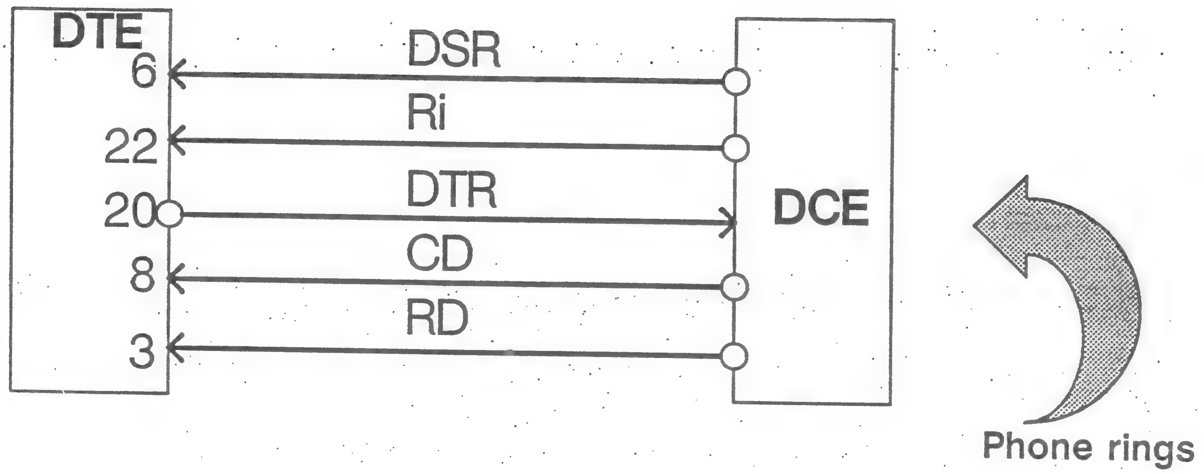


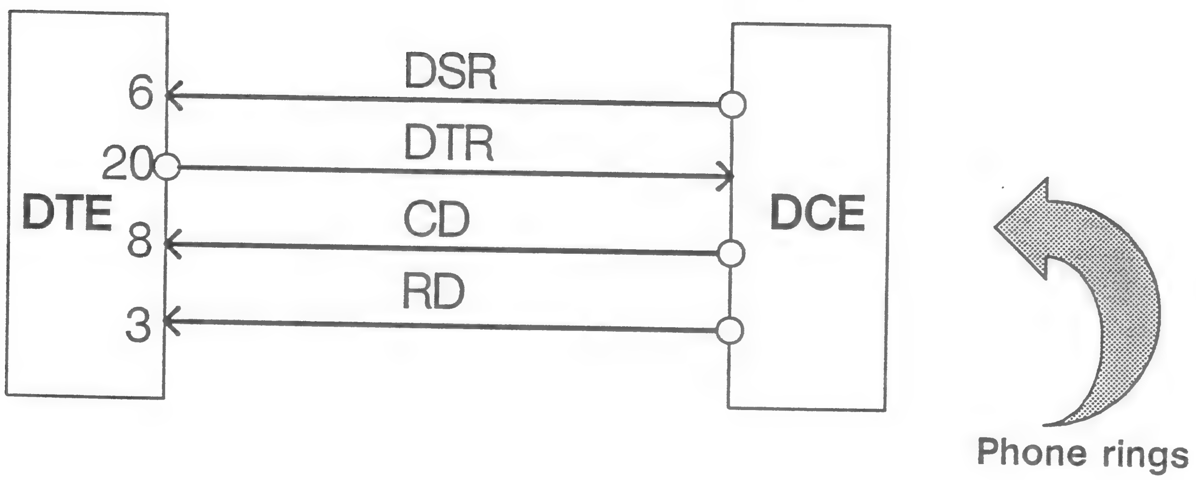
VIEWED FROM CABLE SIDE

Computer to Modem interface

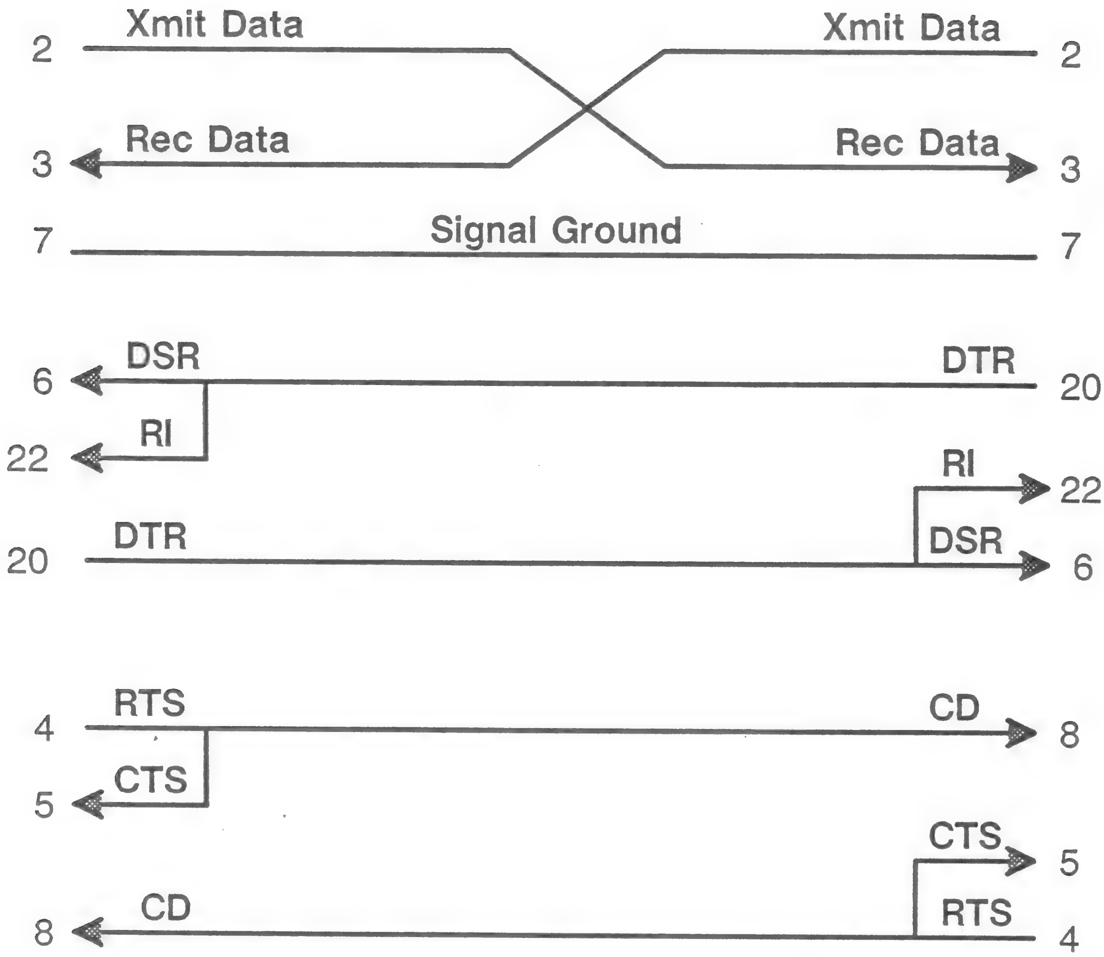


Auto Answer

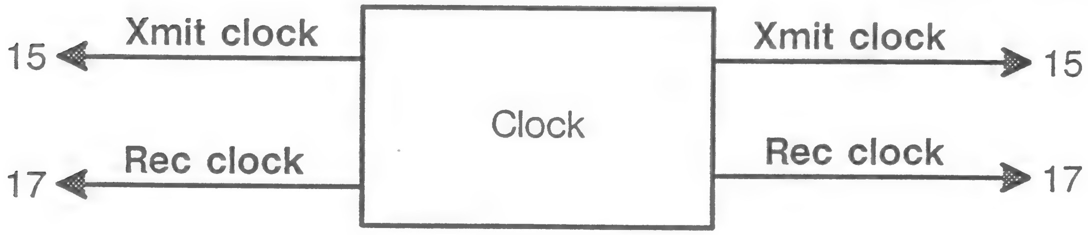

DTE
6
22
20
8
3
DSR
Ri
DTR
CD
RD
DCE
Phone rings


DTE
6
20
8
3
DSR
DTR
CD
RD
DCE
Phone rings

Modem Eliminator

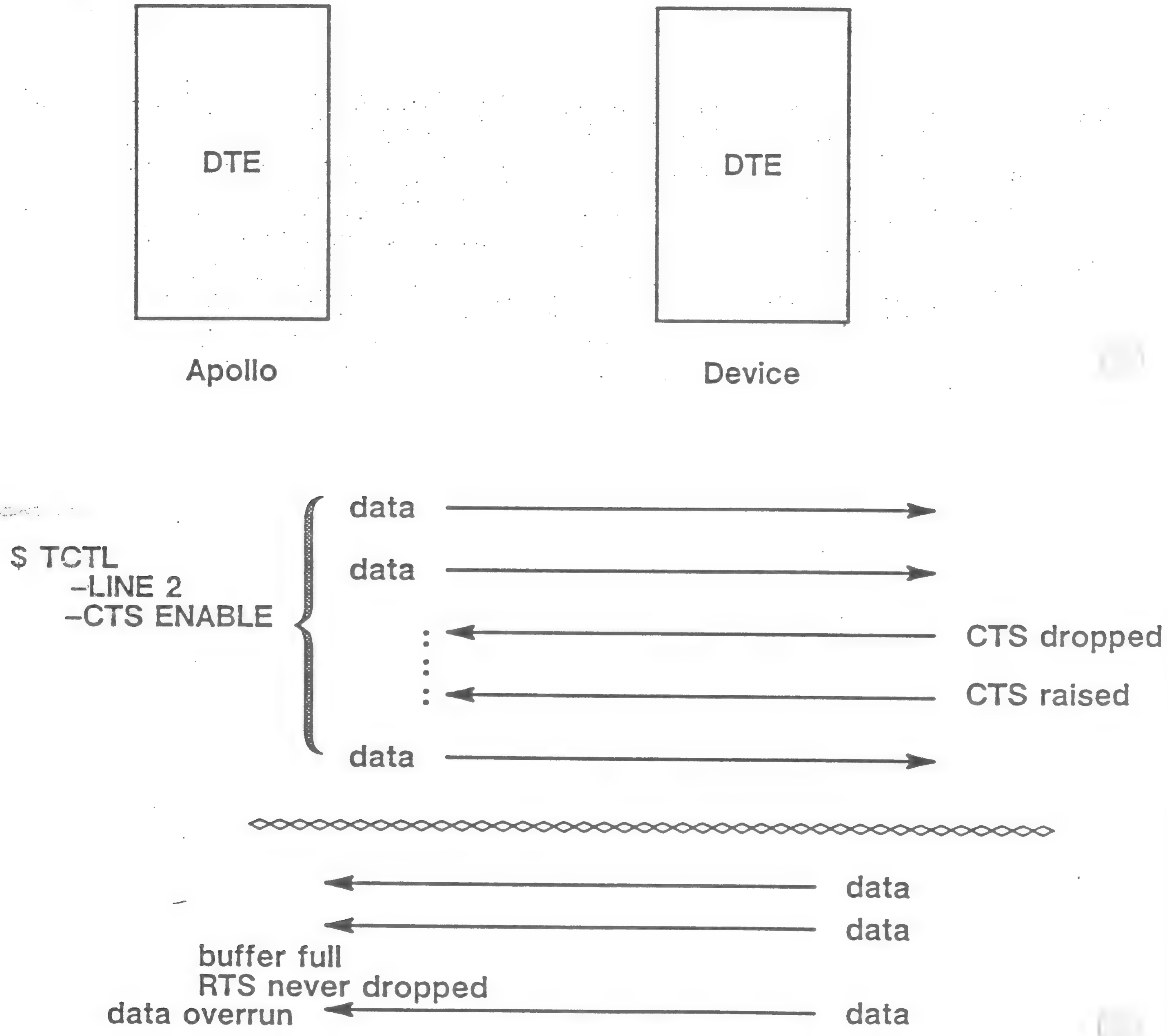


Required for Synchronous connections only



Flow Control at Physical Layer

This problem has not been defined in RS232-C recommendation.



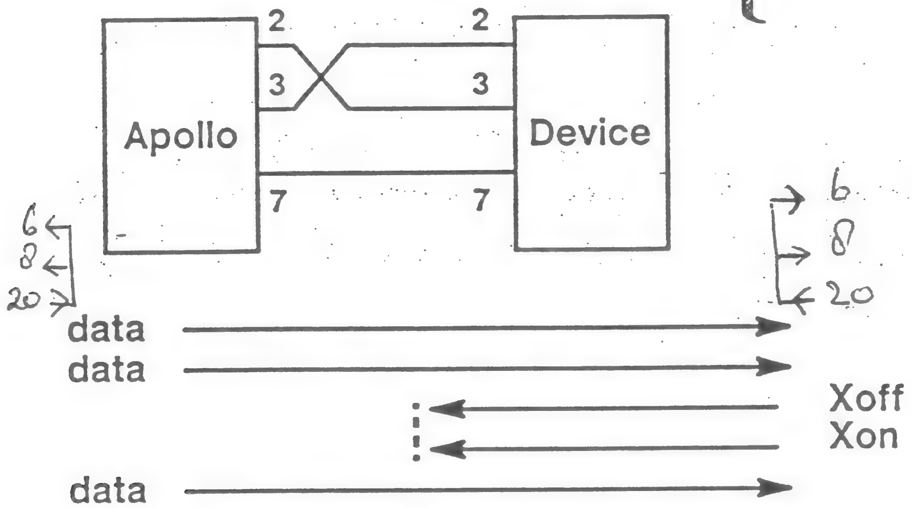
Software Flow Control

Xon = DC1 = 11 hex = control/Q gadoor.

Xoff = DC3 = 13 hex = control/S stop transmissie

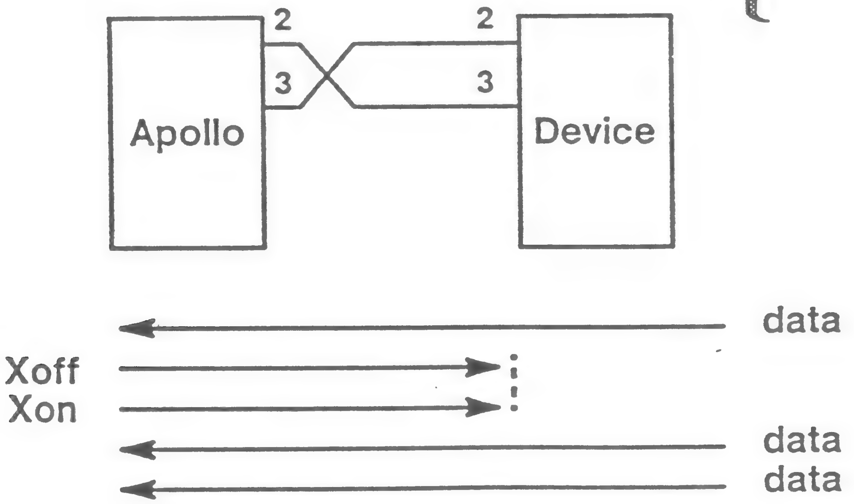
$ TCTL –LINE 2 –INSYNC

Note: Shows up as input_sync on $ TCTL



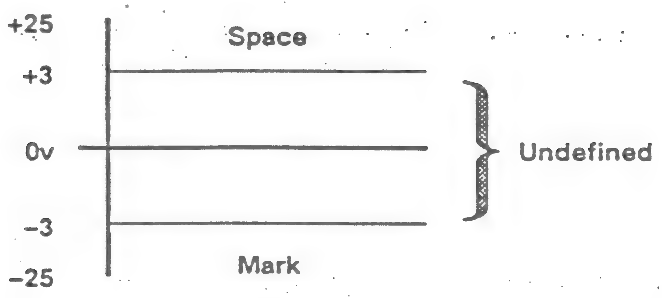
$ TCTL –LINE 2 –SYNC

Note: Shows up as host_sync on $ TCTL



RS232–C Facts

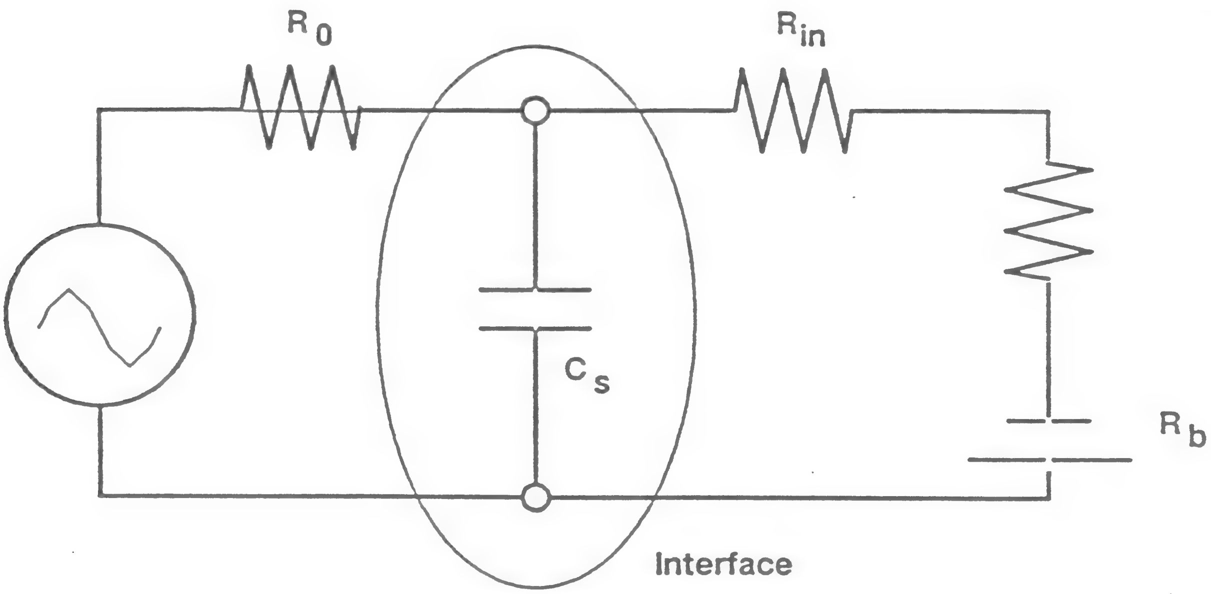
RS232–C



Apollo + en - 5V
meestal + en - 12V.

Maximum cable length: 50 feet

Maximum speed: 19.2 kbps



RS449, 422, 423

RS449 is a mechanical specification

- # of pins
- size of pins
- size of connector
- cable length

9pins connector.

RS422 electrical specification

- 1.2 megabit per second
- Balanced mode

RS423 electrical specification

- 56 k bit per second
- unbalanced

Comparison of RS-449, RS-232C

RS-449		RS-232C		CCITT Recommendation V.24	
SG	Signal Ground	AB	Signal Ground	102	Signal Ground
SC	Send Common			102a	DTE Common
RC	Receive Common			102b	DCE Common
IS	Terminal In Service				
IC	Incoming Call	CE	Ring Indicator	125	Calling Indicator
TR	Terminal Ready	DC	Data Terminal Ready	108/2	Data Terminal Ready
DM	Data Mode	CC	Data Set Ready	107	Data Set Ready
SD	Send Data	BA	Transmitted Data	103	Transmitted Data
RD	Receive Data	BB	Received Data	104	Received Data
TT	Terminal Timing	DA	Transmitter Signal Element Timing (DTE Source)	113	Transmitter Signal Element Timing (DTE Source)
ST	Send Timing	DB	Transmitter Signal Element Timing (DCE Source)	114	Transmitter Signal Element Timing (DCE Source)
RT	Receive Timing	DD	Receive Signal Element Timing	115	Receiver Signal Element Timing (DCE Source)
RS	Request to Send	CA	Request to Send	105	Request to Send
CS	Clear to Send	CB	Clear to Send	106	Ready for Sending
RR	Receiver Ready	CF	Received Line Signal Detector	109	Data Channel Received Line Signal Detector
SQ	Signal Quality	CG	Signal Quality Detector	110	Data Signal Quality Detector
NS	New Signal				
SF	Select Frequency			126	Select Transmit Frequency
SR	Signaling Rate Selector	CH	Data Signal Rate Selector (DTE Source)	111	Data Signaling Rate Selector (DTE Source)
SI	Signaling Rate Indicator	CI	Data Signal Rate Selector (DCE Source)	112	Data Signaling Rate Selector (DCE Source)
SSD	Secondary Send Data	SBA	Secondary Transmitted Data	118	Transmitted Backward Channel Data
SRD	Secondary Receive Data	SBB	Secondary Received Data	119	Received Backward Channel Data
SRS	Secondary Request to Send	SCA	Secondary Request to Send	120	Transmit Backward Channel Line Signal
SCS	Secondary Clear to Send	SCB	Secondary Clear to Send	121	Backward Channel Ready
SRR	Secondary Receiver Ready	SCF	Secondary Received Line Signal Detector	122	Backward Channel Received Line Signal Detector
LL	Local Loopback			141	Local Loopback
RL	Remote Loopback			140	Remote Loopback
TM	Test Mode			142	Test Indicator
SS	Select Standby			116	Select Standby
SB	Standby Indicator			117	Standby Indicator

x.21

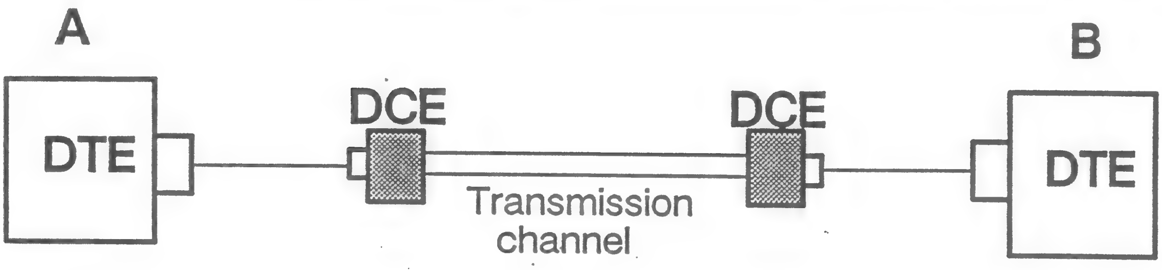
- introduced 1976
- direct digital connection
- only six signals
- electrical specification in x.26
- minimum line speed 64k bits per second
- not a dedicated circuit per function
  +++ means phone is ringing on RD line
  - all call progress signals have special characters
- x.21 bis means use RS232–C until updated

Interchange Circuit	Name	To DCE	From DCE
G	Signal Ground or Common Return	(Note)	
Ga	DTE Common Return	X	
T	Transmit	X	
R	Receive		X
C	Control	X	
I	Indication		X
S	Signal Element Timing		X
B	Byte Timing		X

NOTE See Recommendation X.24.

Pad = packet assembler disassembler.

3 & 5. The Data Communications equipment (DCE)



Would normally be a Modem or multiplexer

MODEM CONFIGURATIONS

Modulation technique

1. Amplitude modulation
2. Frequency modulation / FSK.
3. Phase modulation

Speed and mode

110 Baud Simplex
300 Baud Full Duplex
1200 Baud Half Duplex
1200/75 Baud Full Duplex
1200 Baud Full Duplex
etc

Protocol

1. Asynchronous
2. Synchronous

Interface

RS232–C
X.21
RS449/RS422 or RS423
etc.

Transmission medium type

Public Switched Telephone Network (PSTN)
Public Switched Data Network (PSDN)
Leased or Private wires
etc

Auto Answer ?

Multiplexers

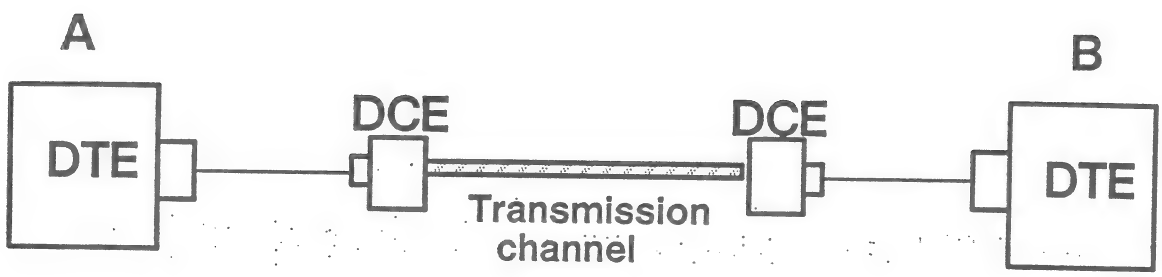
1. Time division multiplexer (DTE Concentrator)

2. Statistical multiplexer

3. Frequency division

	Baud	Data	Fall Back	Duplex	
V21	300	300	No	Full	
V23	1200/75	1200/75	600	Half.	
V22	600	1200	600	Full	4PM
V22.bis	600	2400	1200	Full	QAM/4PM
V32	2400	9600	4800	Full	QAM

4. The Transmission medium



The Physical Medium

1. Twisted Pair
2. Coaxial cable
3. Fibre Optic
4. Microwave
5. Satalite

Characteristics of the Physical medium

Public Swiching Telephone Network
Public Switching Data Network
Private wires and leased lines
Expected Protocol ie X25
Permissible transfer rates / throughput

SIOLOGIN

WATCHES A SINGLE SIO LINE

RUNS THE SHELL SCRIPT
/SYS/SIOLOGIN /STARTUP_SIO.SH

PERFORMS THE LOGIN SEQUENCE

INVOKES SPECIFIED PROGRAM

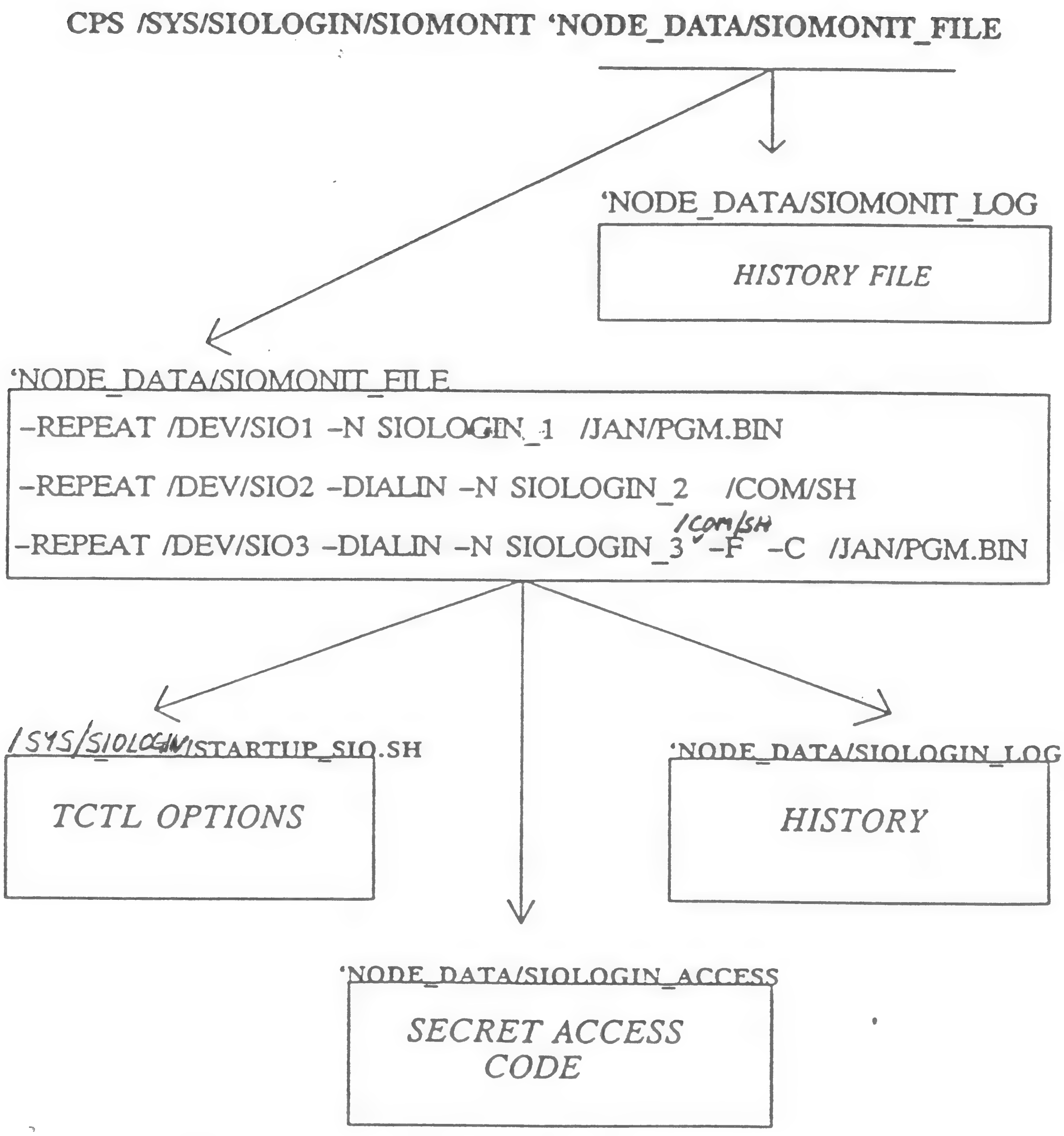
SUPPORTS **DIALIN** AND **DIRECT** CONNECT

ADDITIONAL PASSWORD IN **DIALIN**

ONE LOGIN PER INVOCATION

MUST BE STAMPED IN **LOGIN** SUBSYSTEM

SIOMONIT



-dialing = pend RS232

- access_entry 9 10

LABORATORY EXPERIENCES

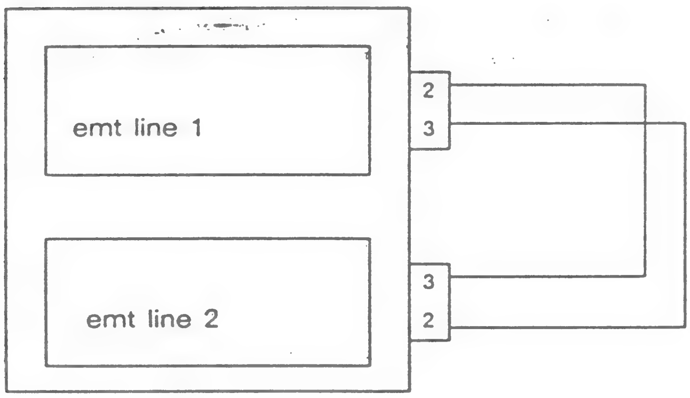
1. Use EMT to write from one sio line to another.

    a. send a string of characters in cooked/raw mode.
    b. send an ascii file.
    c. set up a config file using different emt optons.

2. Send a binary file using siotf and siorf shell commands.

3. Startup siologin and siomonit and login using emt.

    a. use the –dialin option and use a breakout box to simulate carrier detect on pin 8 on the RS232 interface.



Postscript printer
't geeft statusberig.

MODULE 2

DOMAIN PCI

AGENDA

a, DOMAIN TO IBM PC CONNECTION

b, SOFTWARE , HARDWARE REQUIREMENTS

c, SOFTWARE INSTALLATION AND OPERATION

d, LAB 2

DomainPCI 4.0 voordeel!

DPCI 1
8
ring
Enet

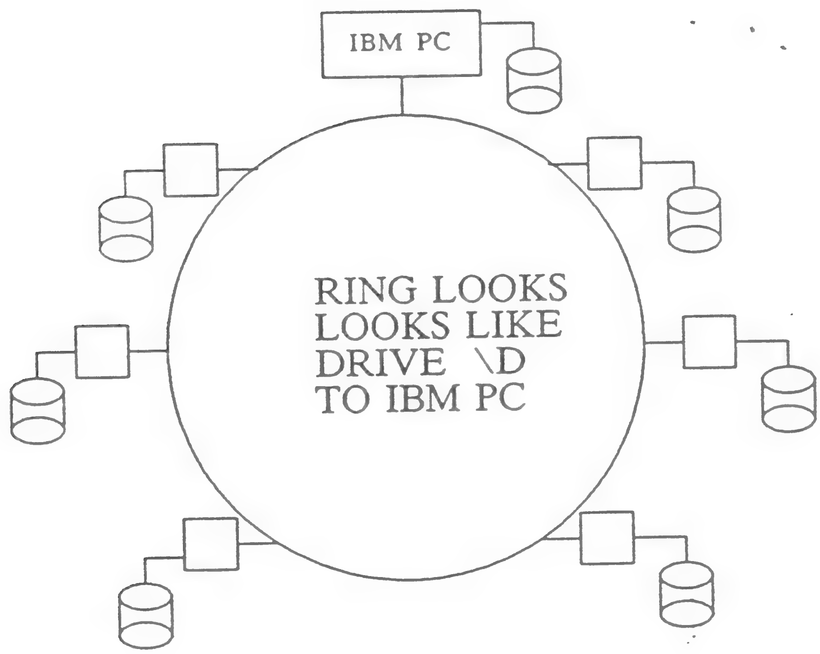
DOMAIN PCI CONNECTION

APOLLO EMULATES IBM DISK

PC CAN COPY FROM ITS DISK TO RING

PC CAN COPY FROM RING TO ITS DISK

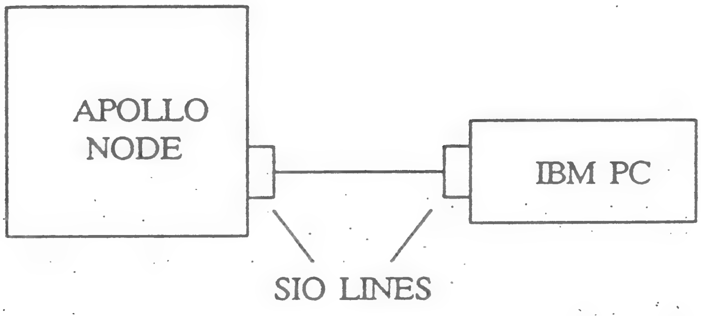
THE SHELL IS AVAILIABLE TO THE PC
USING THE DTERM COMMAND



FILES ON THE IBM PC DISK ARE NOT
AVAILBLE TO THE DOMAIN RING

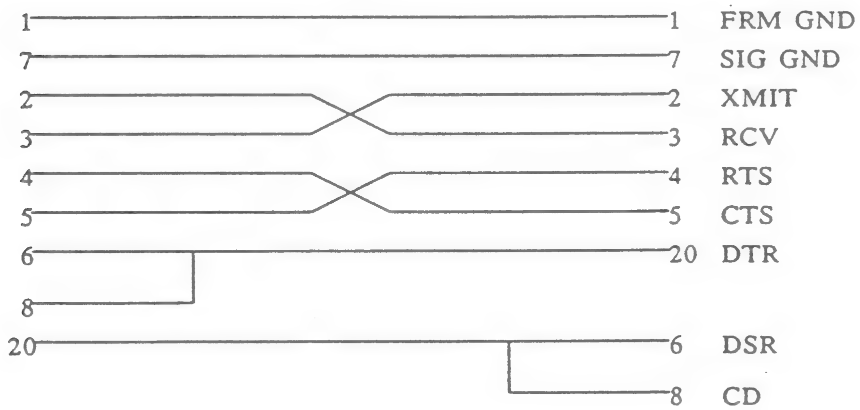
REF PPCI

THE DOMAIN/PCI CONNECTION



A PC CONNECTED TO APOLLO

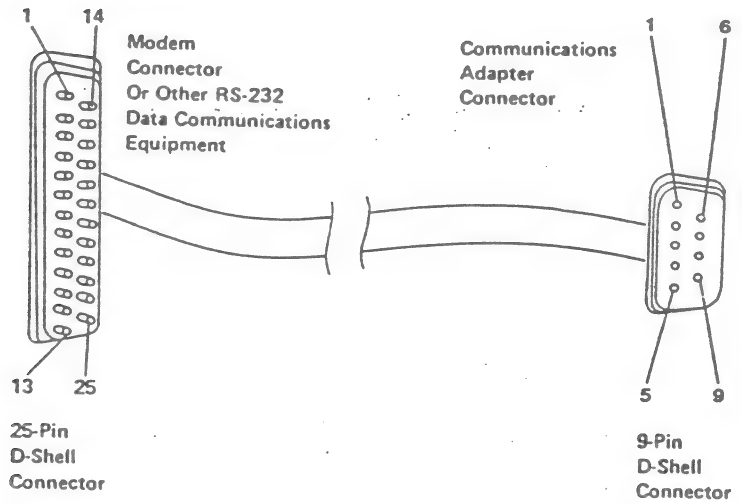
NOTE: A SPECIAL NULL MODEM CABLE IS REQUIRED

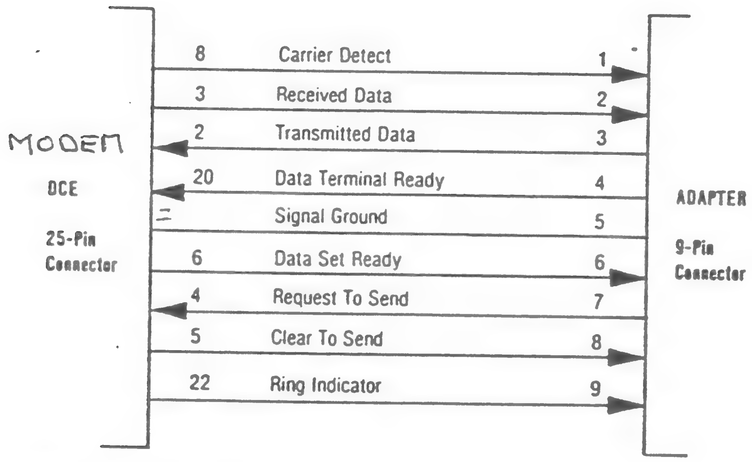


REF PPCI P 4.12

Specifications

One connector is a 9-pin D-shell connector and the other is a 25-pin D-shell connector. The pin numbering and connector specifications follow.





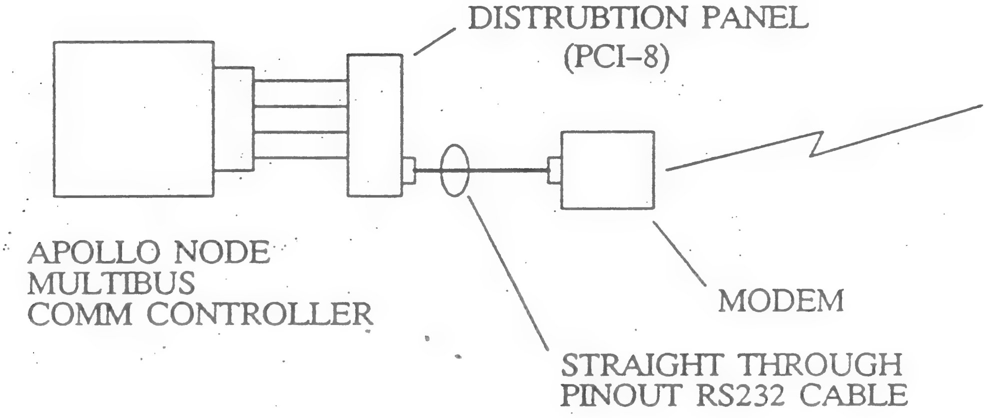
NOTE: ALL OTHER PINS ON THE 25-PIN CONNECTOR ARE NOT USED.

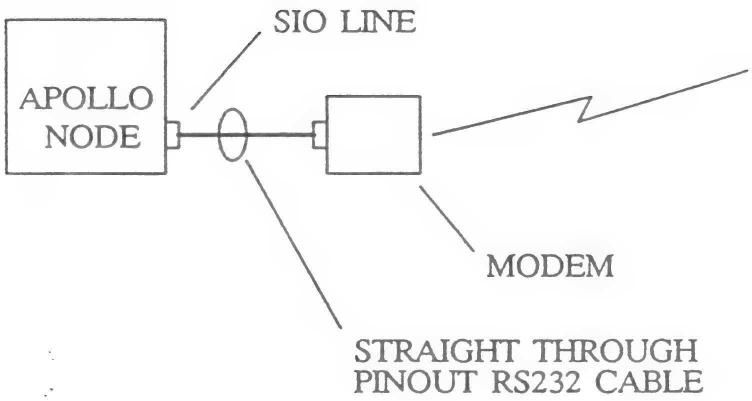
CONNECTOR SPECIFICATIONS

CABLE REQUIREMENTS

IF YOU ARE USING A MODEM

AS PICTURED





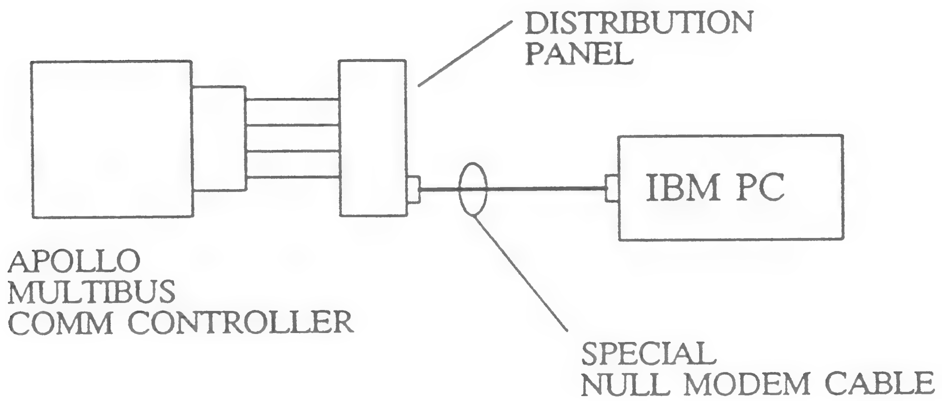
THEN

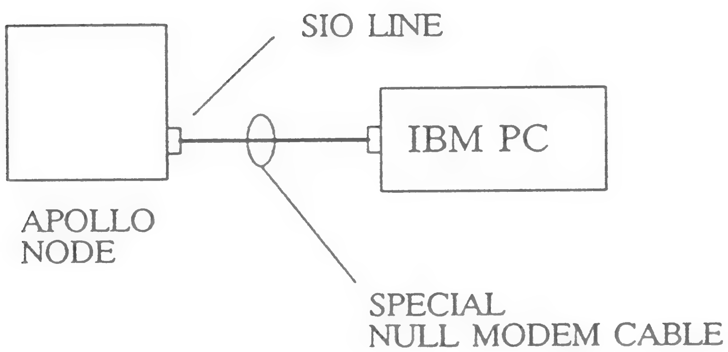
THE RS232–C CABLE IS A STRAIGHT THOUGHT, PIN FOR PIN CABLE.

CABLE REQUIREMENTS

HOWEVER, IF

THE SETUP USED IS AS PICTURED





THEN

THE SPECIAL NULL MODEM CABLE MUST BE USED.

PCI CONFIGURATION FILES

Domain files

/SYS/DPCI1|8/PCI_CMD.DAT

Contains the offers availible to PC users.It contains two default offers, AEGIS giving users access to the Domain network ,assigned to device D: and PRINT giving users access to the Apollo node default printer, assigned to device LPT2.Other offers are added as required, but the PC's and the server must be restarted before the new offers can be used.

```
OFFER AEGIS=// \BLOCK
OFFER PRINT=-PRLW -LEFT 0.25 -S //NODE_528D \CHAR
OFFER PETE=/PETE \BLOCK
OFFER LASER=-PRQMS -LEFT 0.25 -S //NODE_8849 \CHAR
OFFER DOC=//NODE_528D/DOC \BLOCK
```

offer naam= -pr printernaam
[-pcprint]
[-Transparent]
[-font naam]
[aegis prf opties]
\char
[-Not translate]
[-setup pagina]

/SYS/DPCI1|8/PCI_CVRT.DAT

Contains a list of file extensions to be treated as ASCII files to enable conversion to/from UASC (Unstructured ASCII as used by Apollo nodes) and ASCII as used by the PC, when files are accessed or copied.

```
asm
bak
bat
c
dat
doc
ftn
h
lst
map
pas
txt
```

/SYS/DPCI8/PCI_CFG.DAT

For PCI-8 only.Contains line specific configuration data

```
-line 1 -baud 9600 -retries 10 -timeout 12
-line 2 -baud 9600 -retries 10 -timeout 12
-line 3 -baud 9600 -retries 10 -timeout 12
-line 4 -baud 9600 -retries 10 -timeout 12
-line 5 -baud 9600 -retries 10 -timeout 12
-line 6 -baud 9600 -retries 10 -timeout 12
-line 7 -baud 9600 -retries 10 -timeout 12
-line 8 -baud 9600 -retries 10 -timeout 12
```

PC files

C:\DPCI\HDAUTO.BAT

Executed on the PC to start domain connection when the PC has a fixed disk.

```
ECHO OFF
: *** DOMAIN(R)/PCI(TM) Client Installation File ***
ECHO ON
pause  Do you wish to start the DOMAIN(R)/PCI(TM) Client?  Cntrl-c if not.
cd c:\dpci
xport %1 %2 %3 %4
if errorlevel 1 goto a
session netaddr
setname PC
redir /p1:10000
: *** Insert your individual NET USE commands here ***
net use d: \\DOMAIN\AEGIS
net use lpt2: \\DOMAIN\PRINT
cd c:\
echo off
echo ---------------------------------------------------------------
echo     Drive D: is connected to the root of the DOMAIN File System
echo     and Device lpt2: is connected to the DOMAIN printer if the
echo     above commands completed successfully.
echo ---------------------------------------------------------------
echo     DOMAIN(R)/PCI(TM) Client Rel 2.0
echo     Copyright 1984,1985, Microsoft(TM),
echo     MS-NET(R), all rights reserved.
echo ---------------------------------------------------------------
goto b
:a
echo off
echo ---------------------------------------------------------------
echo     Restart PCI failed.  Shut down your PC and reboot.
echo ---------------------------------------------------------------
:b
```

C:\DPCI\PCI.BAT

Executed on the PC to start domain connection when the PC has only floppy disks.

```
ECHO OFF
: *** DOMAIN(R)/PCI(TM) Client Startup File ***
: ***
ECHO ON
xport %1 %2 %3 %4
if errorlevel 1 goto a
session netaddr
setname PC
redir /p1:10000
: *** Insert your NET USE commands here ***
NET use d: \\DOMAIN\AEGIS
net use lpt2: \\DOMAIN\print
echo off
echo ------------------------------------------------------------
echo     Drive D: is connected to the root of the DOMAIN File System
echo     and Device lpt2: is connected to the DOMAIN printer if the
echo     above commands completed successfully.
echo ------------------------------------------------------------
echo     DOMAIN(R)/PCI(TM) Client Rel 2.0
echo     Copyright 1984,1985, Microsoft(TM),
echo     MS-NET(R), all rights reserved.
echo ------------------------------------------------------------
goto b
:a
echo off
echo ------------------------------------------------------------
echo     Restart PCI failed.  Shut down your PC and reboot.
echo ------------------------------------------------------------
:b
```

C:\CONFIG.SYS

Executed by the PC at boot time to configure resources.The Lastdrive entry specifies the maximum number of virtual devices you may have,the default is five ie **E**. If you wish to take advantage of additional offers you may have to change the Lastdrive number.The maximum is **Z** ie 26 devices.

buffers=20
files=20
lastdrive=p

PCI LAB

1/ Connect the supplied PCI cable between serial port 1 on the Apollo node and serial port 1 on the PC.

2/ Power on and boot the PC and the Apollo node.

3/ Invoke EMT in a window

EMT> **tctl -line 1 -default**
EMT> **raw**
Press the F1 function key to go on line

4/ Type the following at the Dos prompt to configure serial line 1 on the PC for 9600 Baud, 8 data bits and one stop bit;

C:\>**MODE COM1:96,N,8,1**

5/ Enter the following Dos command to redirect a directory listing to serial line 1 of the PC, which should then be displayed by EMT on the Apollo;

C:\>**DIR >COM1**

6/ Now to test data transfer from the Apollo to the PC,

C:\>**COPY COM1 CON**
At the Apollo type some text to EMT followed by Control Z to terminate transmission. The text should appear on the PC display.

Having tested the basic functionallity of the connection, it is now time to install the software on both the Apollo and the PC.

P.T.O

PCI LAB cont. Software installation

7/ Follow the PCI release notes to install the software on the Apollo.
PCI software version 2.0 requires 350 disk blocks.

8/ Edit the Offers file **/SYS/DPCI1/PCI_CMD.DAT** to contain the required offers.There are two offers by default as shown below:

OFFER AEGIS=// \BLOCK
OFFER PRINT=-PRP \CHAR

Add a third offer to point to another nodes /sys/help directory.
OFFER HELP=//NODE_XXXX/SYS/HELP \BLOCK where node_xxxx is another node on the network.

Remember that from the PC Aegis offer you can only access nodes,directories and files that have 8 character max. names with optionally a .xxx three letter extension.Default node names have 9 characters ie NODE_6DC0 therefore you must either create short named links to these items on the Apollo or include them in the Offers file and assign a virtual device on the PC to the required Offer.

9/ Create a link on your node to enable you to access it from the PC

$ CRL //nodexxxx //node_xxxx where xxxx is your node id.

10/ Read the file **/SYS/DPCI1/PCI_CVRT.DAT** it contains all the Dos file extensions that will be considered to be ASCII by DOMAIN.
ie If you copy a file from the pc to the Apollo which has one of these file extensions, the file will be converted from ASCII to UASC. and vice-versa.

11/ Ensure that the project server has access rights to /sys/dpci1

12/ Start the server on the Apollo;
command> **CPS /SYS/DPCI1/SESSION**

You are now ready to install the PC software

PCI LAB cont. PC software installation.

This procedure is for the purposes of this lab using PC's with a fixed disk.
Consult ' Using your Domain connection' manual for PC software installation for other PC configurations.

13/ Check the PC is running DOS version 3.10 or 3.20 with the **VER** command and that there is at least 160K of free space on the fixed disk with the **DIR** command.

14/ Change your default drive to A C:\>**A:**

15/ Enter **pcinstl** and answer the questions

16/ Enter **c:** to change your default drive

17/ Enter **cd \dpci** to change your default directory

18/ Enter **hdauto** to startup the Domain connection

19/ Change your default drive to **D:** and type **DIR**

20/ Change your default directory to nodexxxx then type DIR

D:\>**cd nodeaaa7**

D:\NODEAAA7>**dir**

21/ Explore the Domain system,note you can only see files and directories with up to 8 character names and optionally a . three character extension.Also note a backslash is used as a file specification separator instead of the usual slash character.

22/ Now enable the use of one of your offers

D:\NODEAAA7>**c:**

C:\>**cd \dpci**

C:\DPCI>**net use E: \\domain\help**

C:\DPCI>E:

E:\>**dir**

You are now in another nodes /sys/help directory

23/ Type one of the files with the Dos **Type** command.

Use the **COPY** command to copy a file from the Apollo to the PC

E:\>**copy ld.hlp c:\dpci\ld.hlp**

E:\>C:

C:\DPCI>**dir**

C:\DPCI> **type ld.hlp**

PCI LAB cont.

24/ Print ld.hlp which now resides on the PC with the DOS print command.

C:\DPCI>**print ld.hlp**

Name of list device [PRN]: **LPT2**

Resident part of PRINT installed

C:\DPCI\LD.HLP is currently being printed

C:\DPCI>

25/ Invoke DTERM and login to the Apollo

C:\DPCI>**DTERM**

login: **user**

password

logged in as user on 1987/03/01 Wed 12:37 (GMT)

26/ After entering some AEGIS commands press both shift keys together.This will make Dterm resident on the PC enabling you to switch between Dos and Aegis as required using both shift keys.

27/ When you have finished shut the PC down and Kill the server process on the Apollo

$ sigp –s dpci1_sesxport

END OF LAB

MODULE 3

ETHERNET COMMUNICATIONS

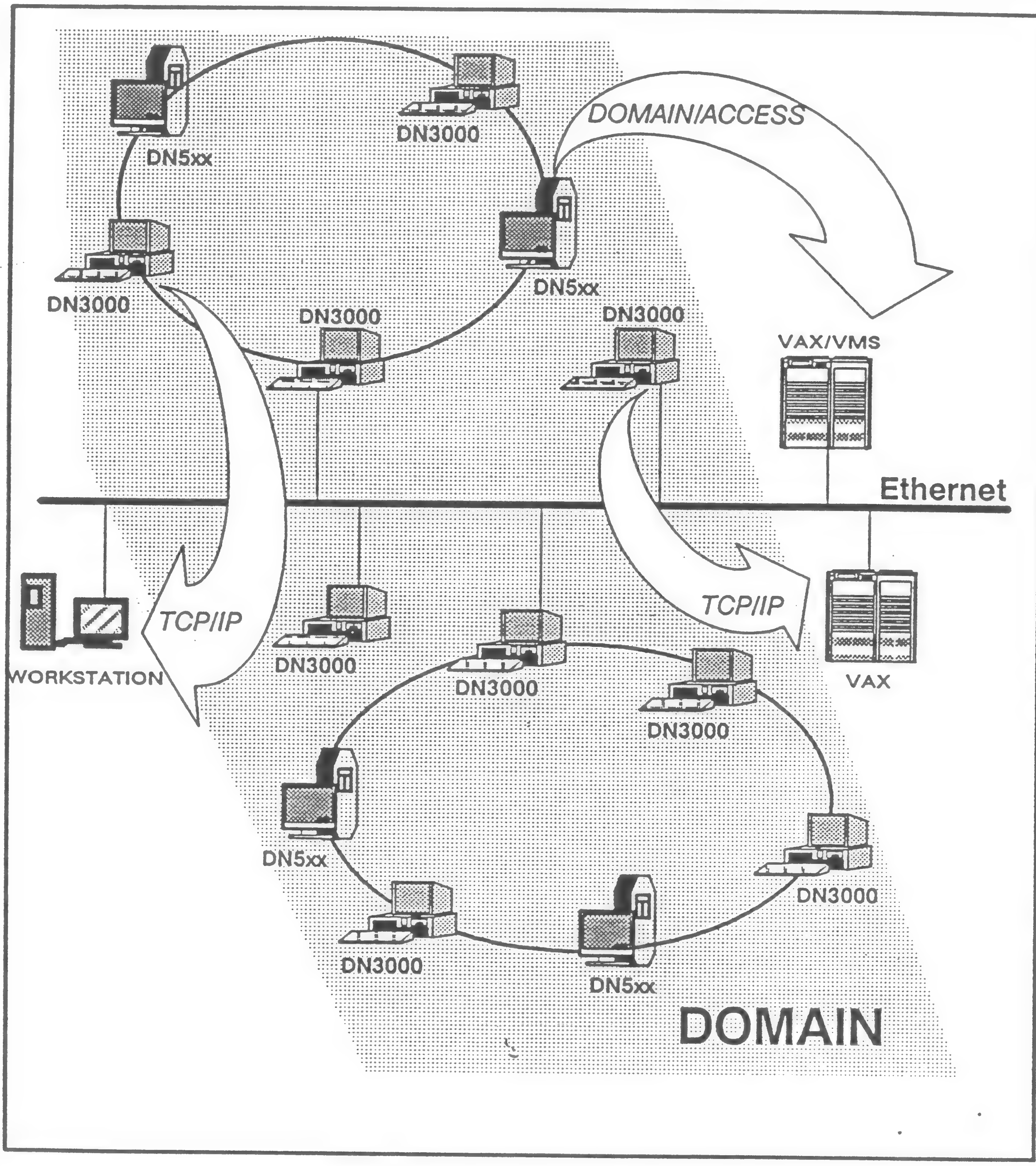
AGENDA

a, GENERAL OVERVIEW OF OPERATION

Ethernet
TCP–IP communications
Native Ethernet
Domain Bridge / Internets

b, ETHERNET SPECIFICATIONS

Standard and Thin Ethernet
Ethernet devices
Configuration guidelines



- ☞ Domain extends across all Apollo Token Ring networks and all Series 3000s attached to the Ethernet network
- ☞ All Apollo nodes can access other systems on the Ethernet network using industry standard TCP/IP protocol

ETHERNET

CONTAINS THE FIRST TWO LAYERS OF THE ISO MODEL

1. PHYSICAL LAYER

   a. 50 ohm cable
   b. transceivers
   c. repeaters
   d. terminators

2. DATA LINK CONTROL

   a. csma/cd
      carrier sense multiple access / collision detect

CONFIGURATIONS

Parameter	Standard 802.3 Cabling System	Thin 802.3 Cabling System
DATA RATE	10 meg per sec	10 meg per sec
SEGMENT SPAN	500 m (1640 ft)	185 m (600 ft)
NETWORK SPAN	2438 m (8000 ft)	914 m (3000 ft)
NODES PER SEGMENT	100	30
NODES PER NETWORK	1024	1024
NODE SPACING	2.5 m (8.2 ft) intervals on cable marker bands	0.5 m (1.6 ft) minimum separation
COAXIAL CABLE	1.0 cm (0.4 in) dia. 50 ohm	0.6 cm (0.25 in) dia. 50 ohm
CONNECTORS	N-series	BNC
TRANSCEIVER INTERFACE	0.9 cm (0.38 in) dia multiway cable with 15 pin, D-series connectors; length up to 50 m (165 ft)	Transceiver on controller; cable connects directly to node through BNC T-conn.
INSTALLATION REQUIREMENTS	Complex taping procedure; for best results, contact a professional cable installer	User-Installable system

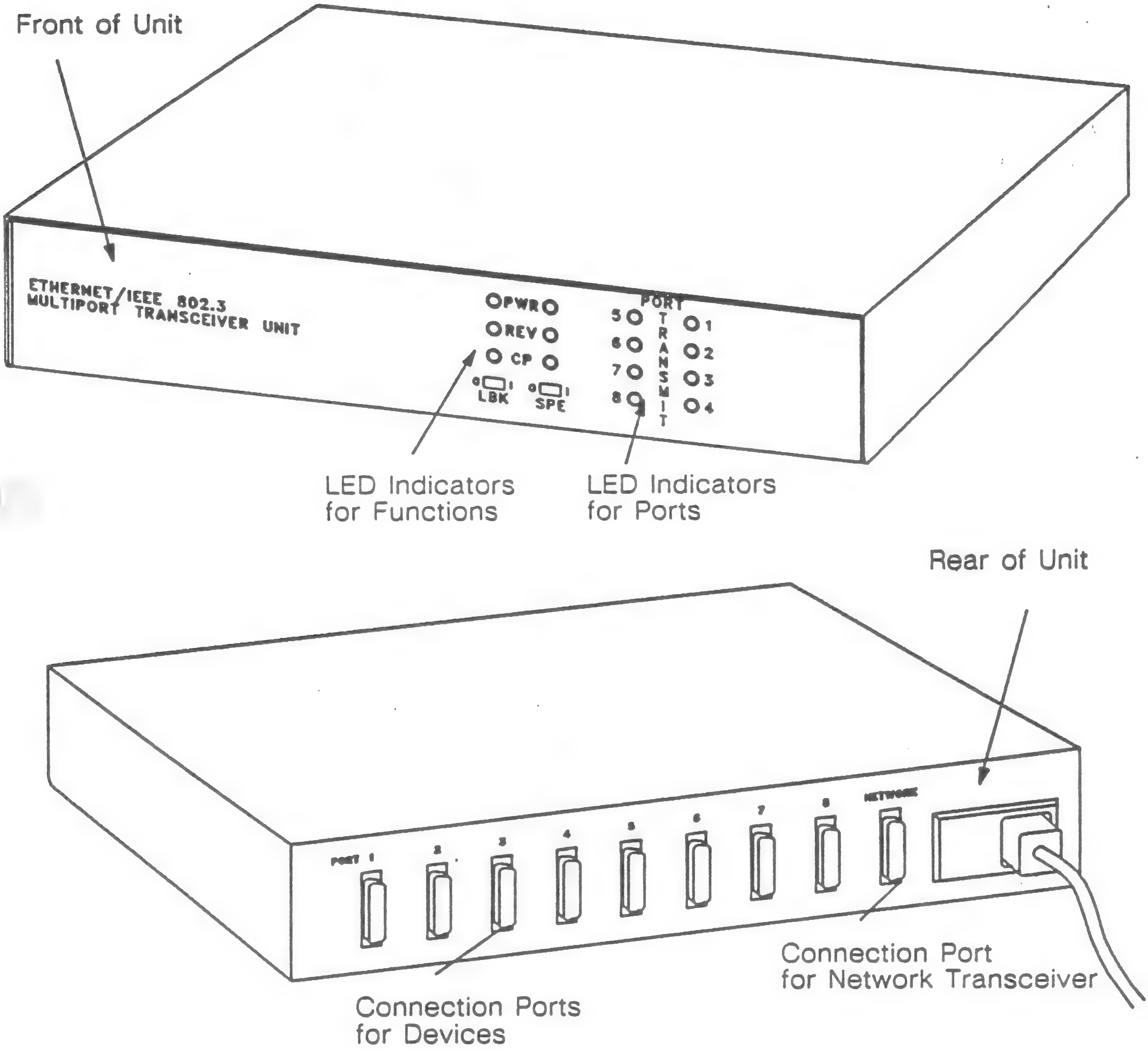


Figure 4-6. Multiport Transceiver

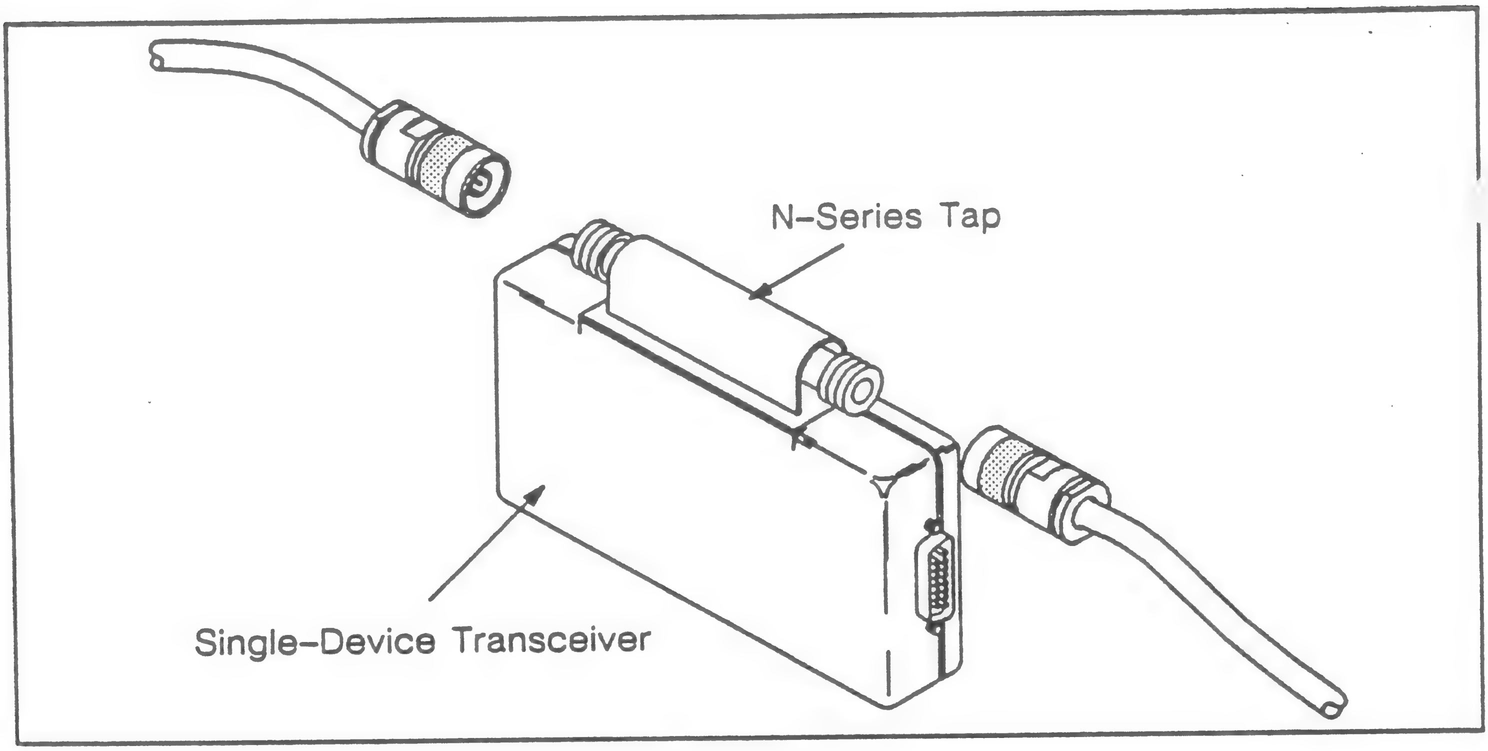


Figure 4-8. N-Series Transceiver Tap

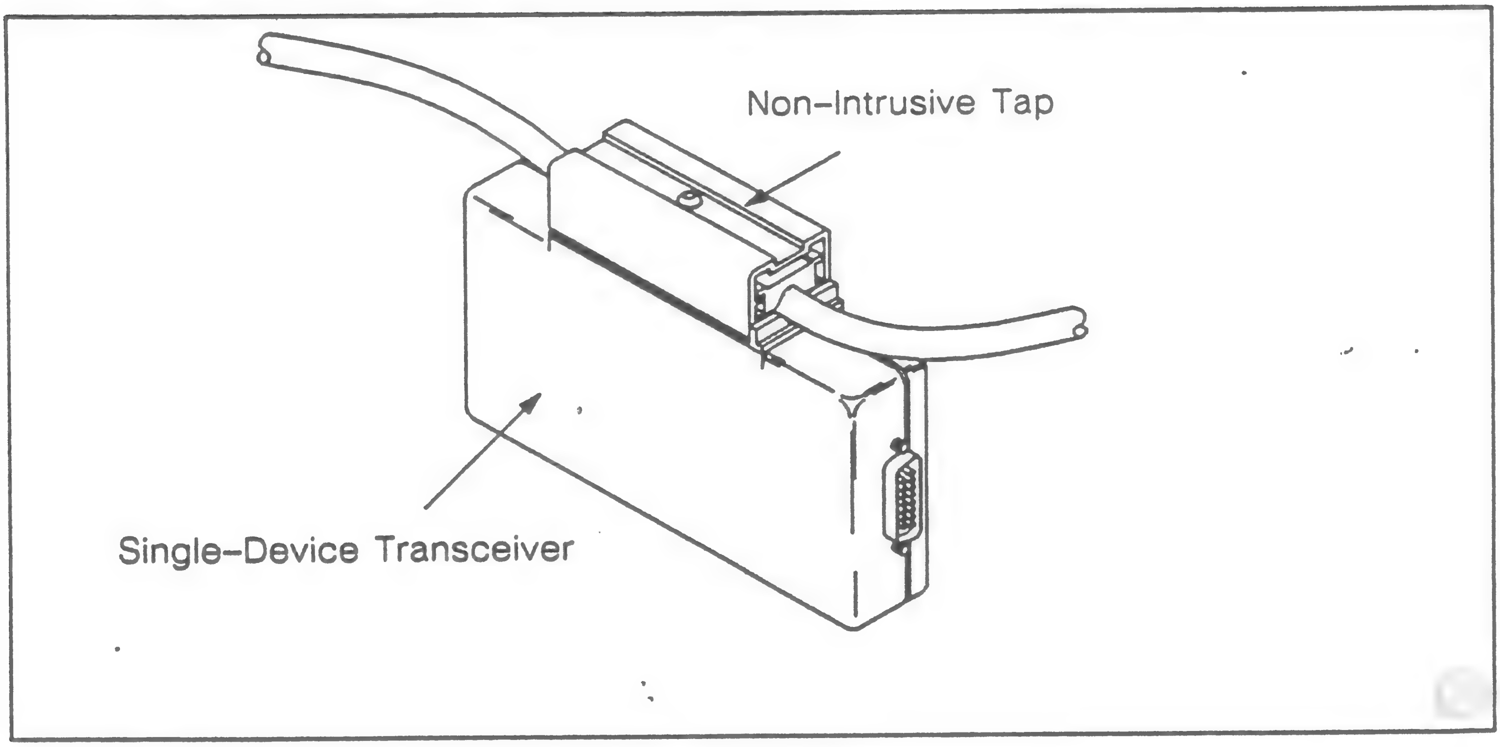
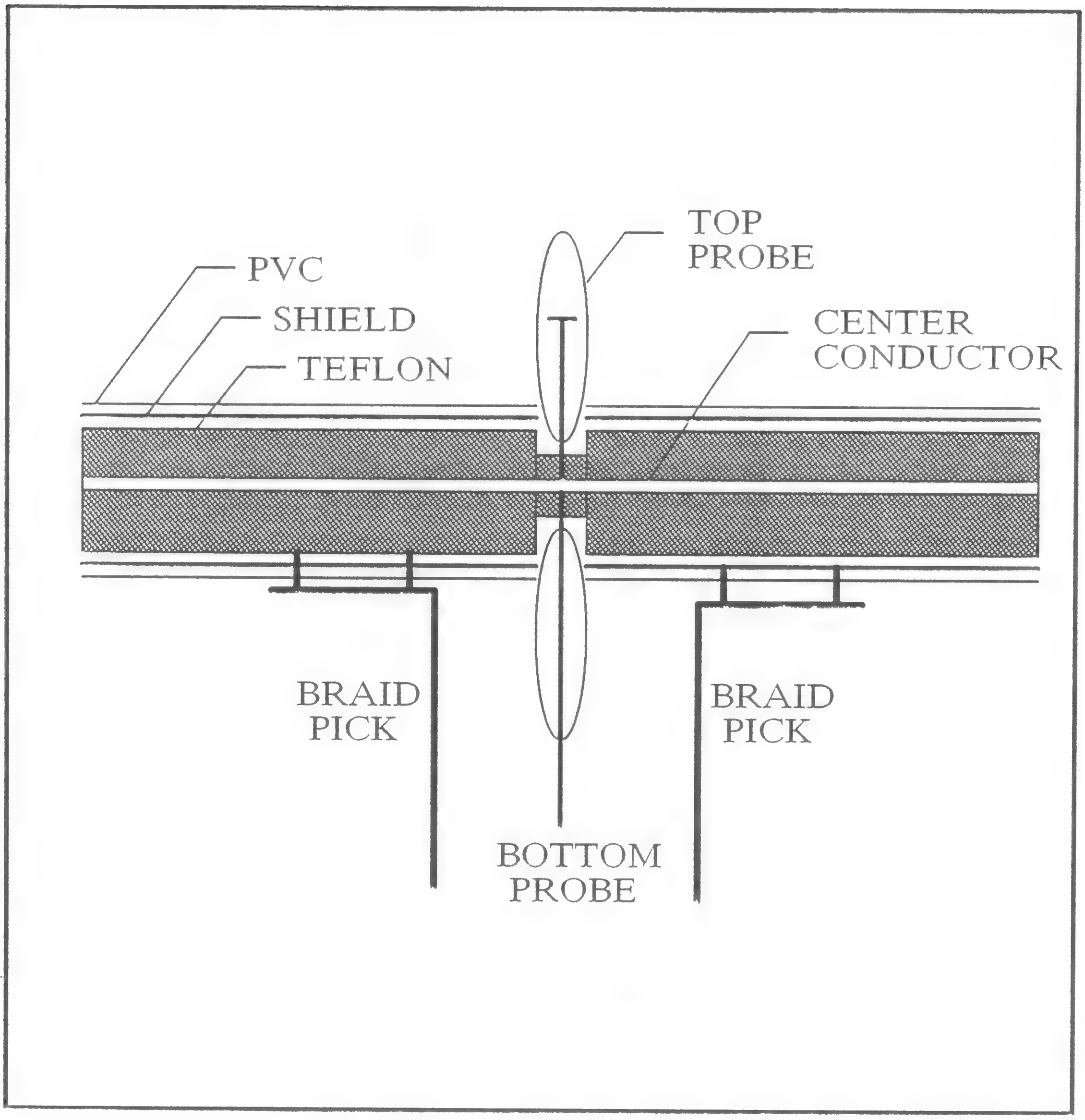


Figure 4-9. Non-Intrusive Transceiver Tap

INTERLAND'S
ETHERNET CABLE TAP



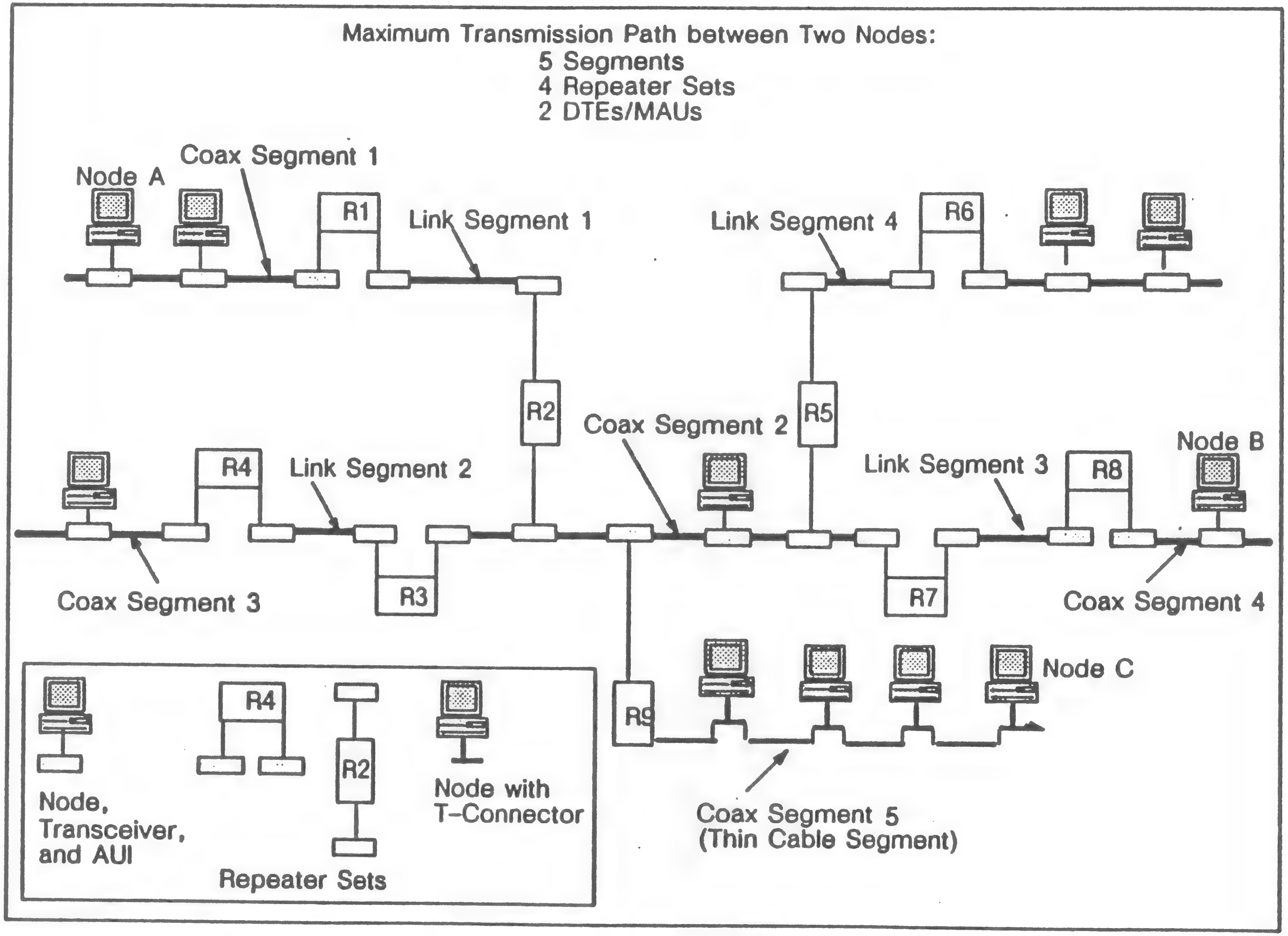


Figure 5-3. A Large IEEE 802.3 Network with Maximum Transmission Paths

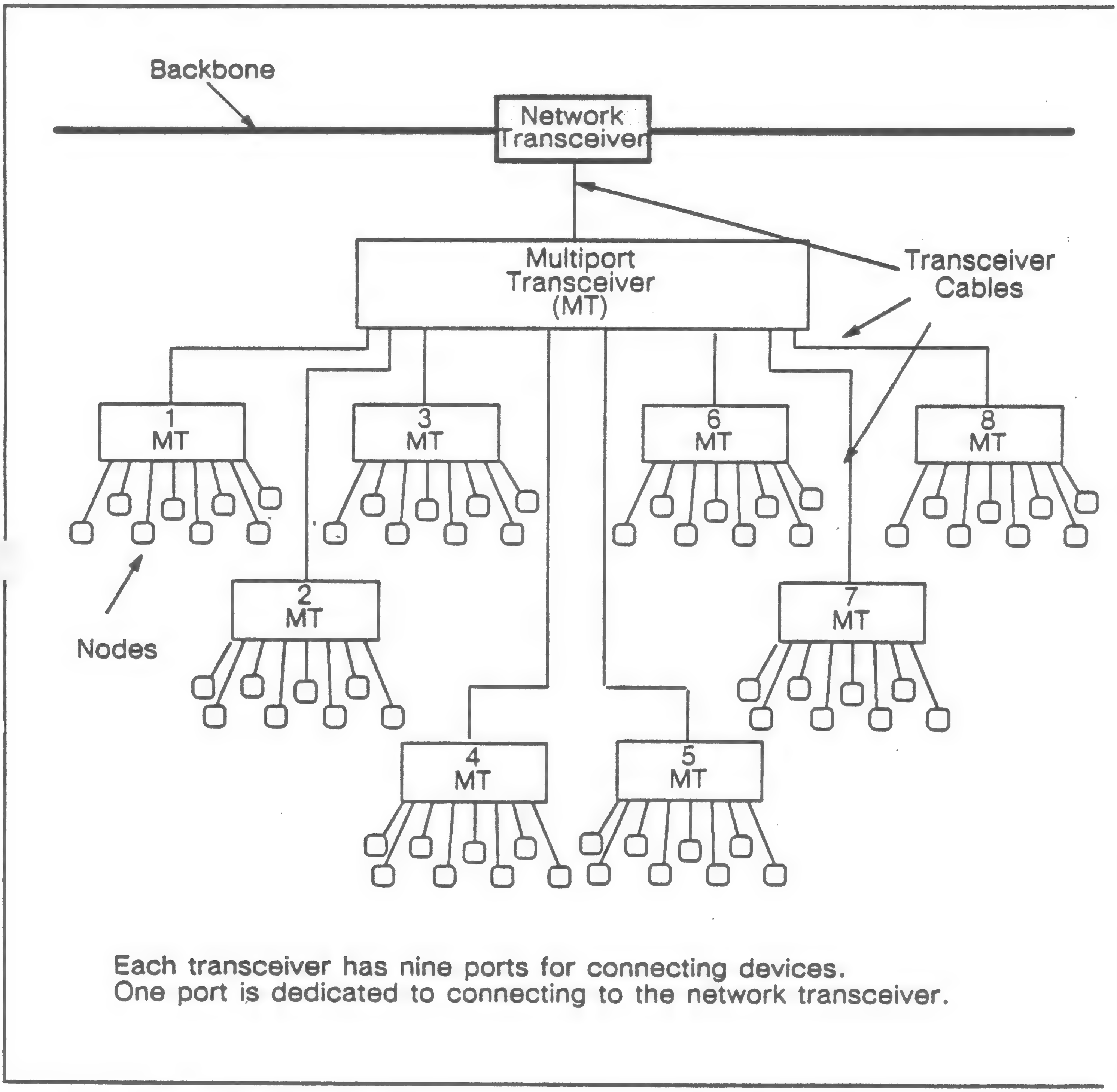
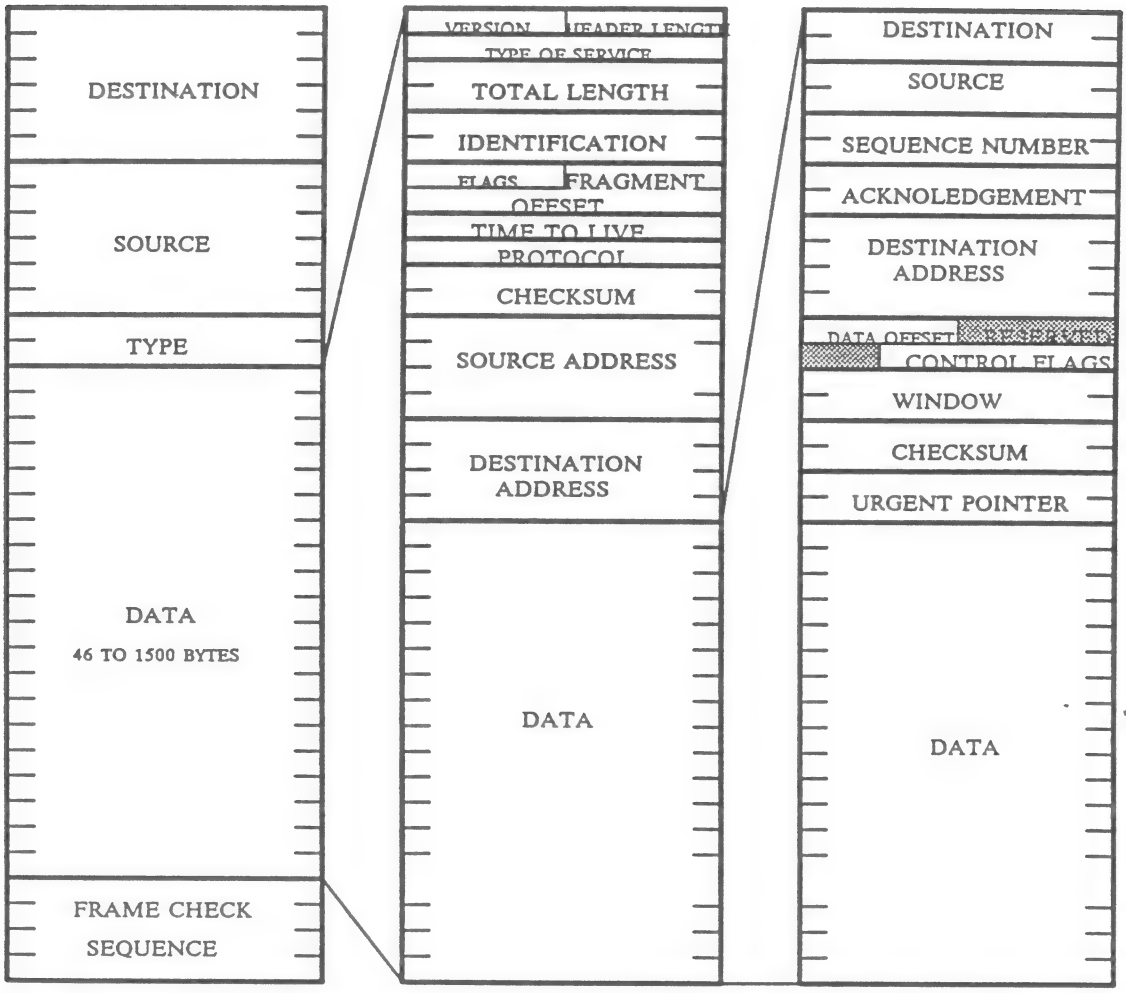


Figure 5–4. Multiport Transceiver in a Cascaded Configuration

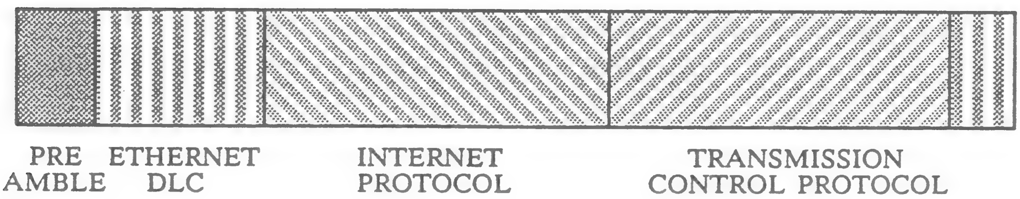
PROTOCOL HEADERS

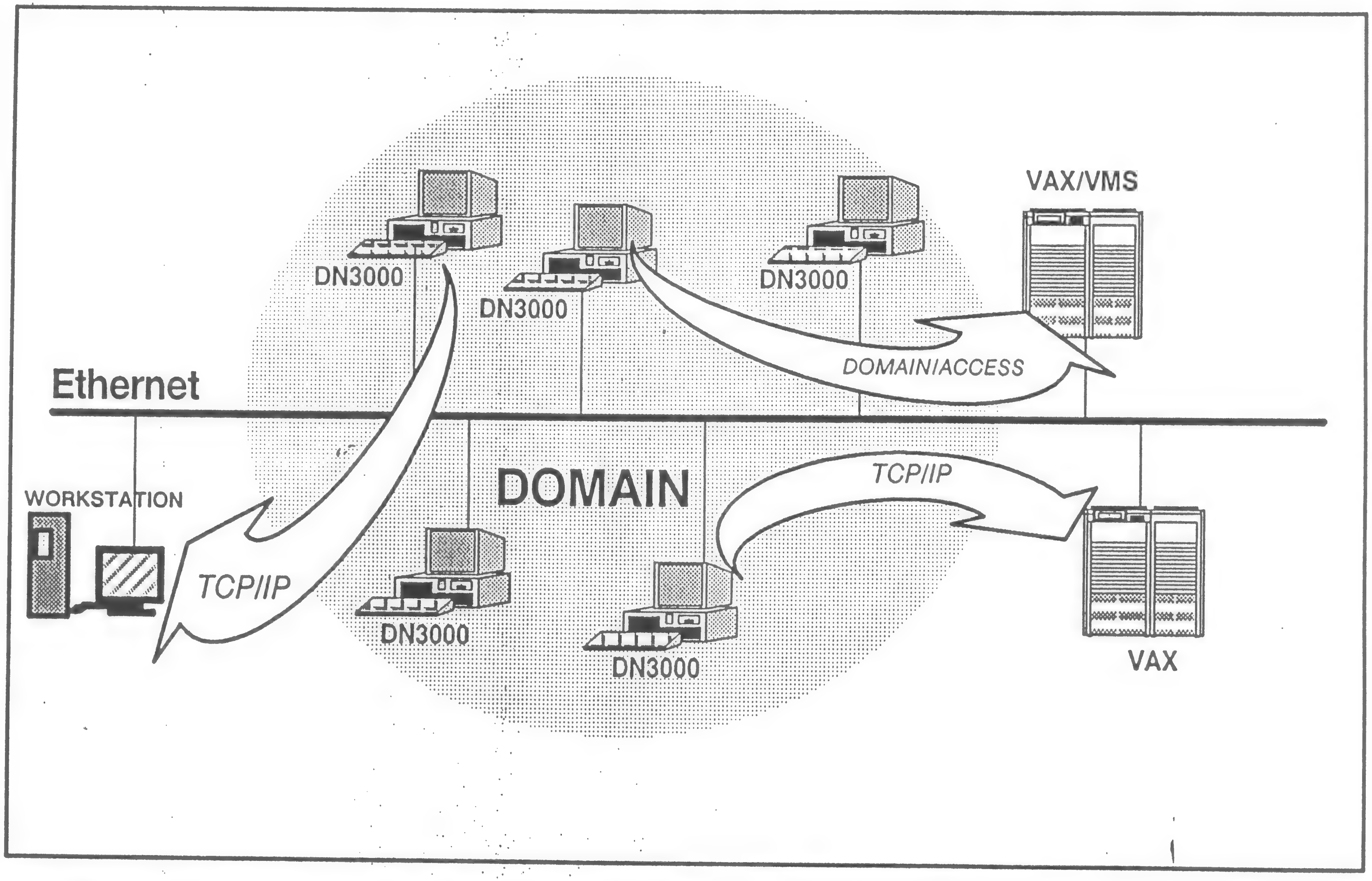


DATA LINK LAYER FRAME FORMAT FOR ETERNET.

INTERNET PROTOCOL FRAME FORMAT

TRANSMISSION CONTROL PROTOCOL HEADER





- Domain encompasses all Series 3000s on the Ethernet network
- Series 3000s communicate with other systems using industry-standard TCP/IP protocol

NATIVE ETHERNET (A_NET_ETH)

THE 802.3 NETWORK CONTROLLER-AT SUPPORTS THE FOLLOWING SERVICES:

Complete Domain services over an IEEE 802.3 Network

Domain workstations connected to an 802.3 network via an 802.3 network controller–AT enjoy full Domain services including diskless booting.

Domain Routing Services.

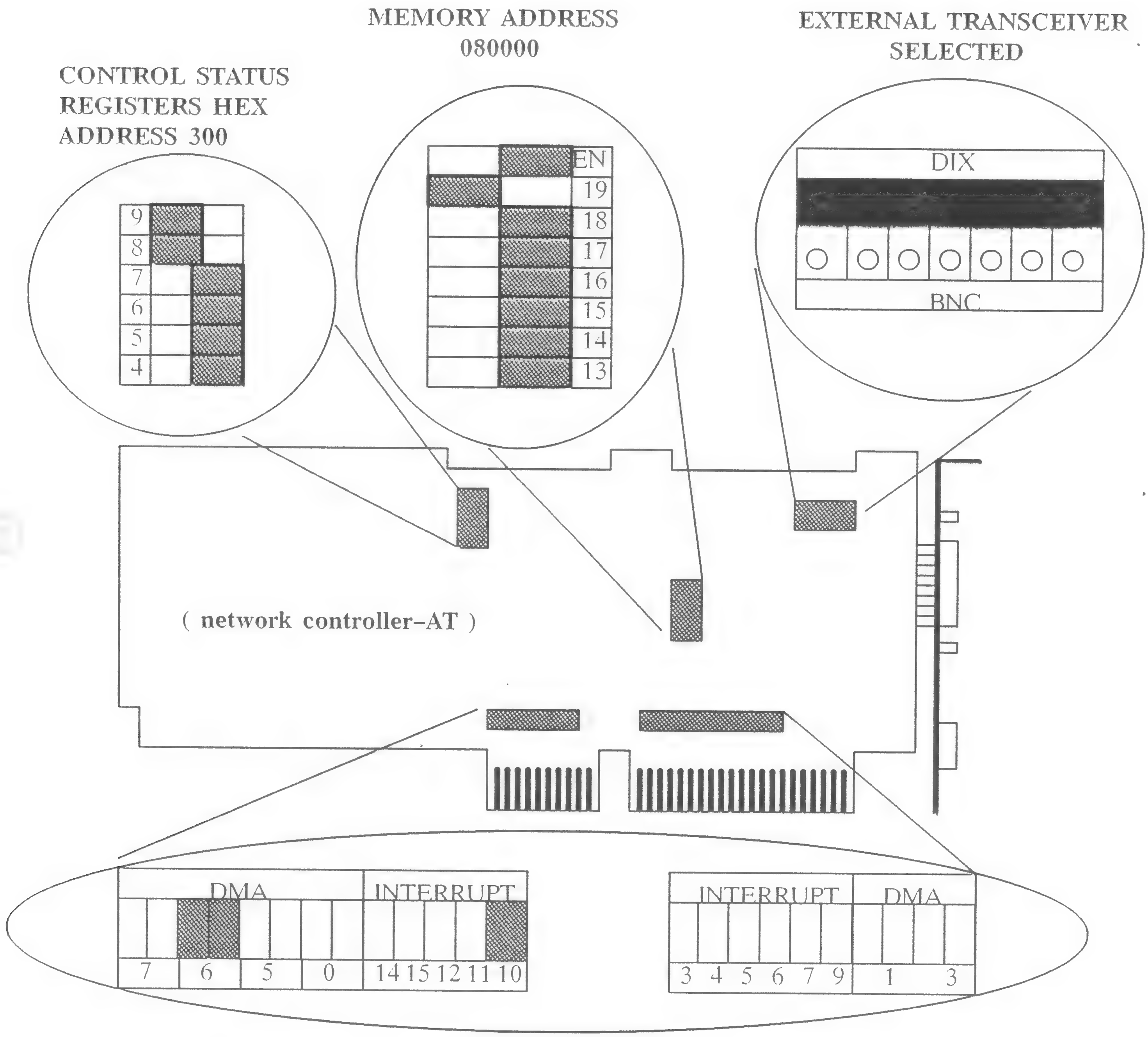
A workstation equipped with two 802.3 Network Controller–AT's can route messages between one 802.3 network and another. A workstation equipped with an 802.3 Network Controller–AT and an Apollo Token Ring Controller–AT (or other network controller) can route messages between an 802.3 network and an Apollo Token Ring (or other) network.

TCP/IP Gateway Services

The controller supports TCP/IP protocols. As a consequence, the 802.3 NEtwork Controller–AT can be useed to communicate with computers from different manufacturers. In addition, the 802.3 Network Controller–AT supports Domain products layered on top of TCP/IP, such as Domain/Access.

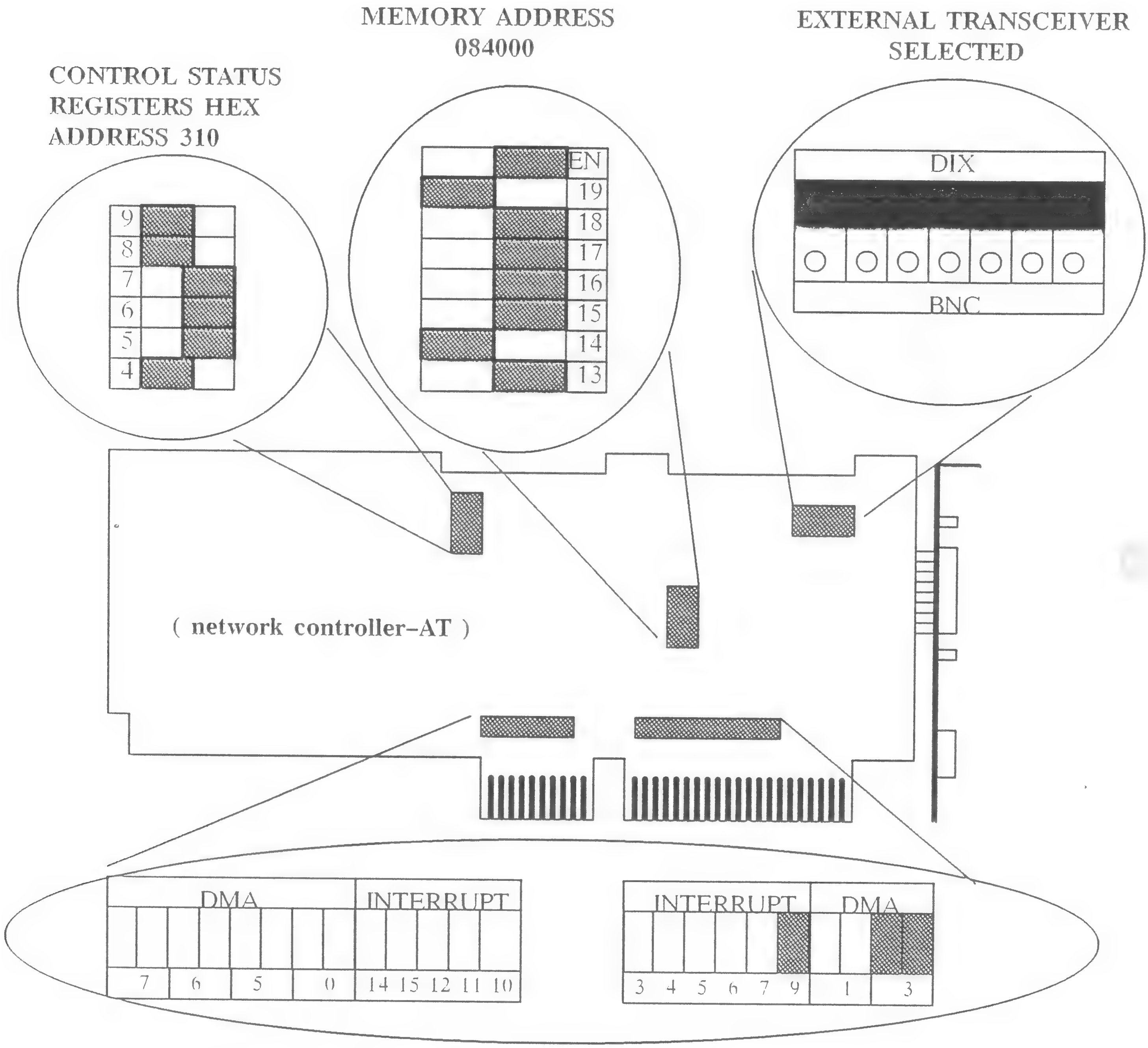
These services are not mutally exclusive. A single workstation equipped with one 802.3 Network Controller–AT can simultaneously provide all of these services. If the workstation routes data to another network, it must also contain a controller for the other network. You can install two 802.3 Network Controller–AT's in a workstation. In this case, all services are available to both controllers.

SETTING JUMPERS ON THE CONTROLLER



DMA CHANNEL 6 AND INTERRUPT LEVEL 10 SELECTED

SETTING JUMPERS ON A SECOND CONTROLLER



DMA CHANNEL 3 AND INTERRUPT LEVEL 9 SELECTED

INSTALLING AND VERIFYING THE NETWORK CONTROLLER-AT

The 802.3 Network Controller-AT operates in any available AT-compatible bus slot. In some systems, slot 1 of the CPU/motherboard is an XT-compatible slot and cannot be used by the network controller board. (In older systems, slot 2 is also an XT-compatible slot). The following table lists the installation order numbers for the AT-compatible bus controller board types.

INSTALLATION ORDER NUMBER	AT-COMPATIBLE BUS CONTROLLER BOARD TYPE
7	**Winchester/Floppy Disk Controller**
6	**Cartridge Tape Controller**
5	**PC Coprocessor**
4	**Graphics Controller**
3	**Apollo Token Ring Network Controller-AT**
2	**802.3 Network Controller** (Installed using this book)
1	**Miscellaneous Controllers**

With the system unit's cover removed, line up the board inside the support brackets and slide the board down toward the slot connector. Make sure the board properly aligns with the slot connector and press firmly into place. Then replace the system unit's cover.

PERFORM THE FOLLOWING STEPS TO VERIFY PROPER OPERATION:

- **Run the CONFIG utility program**
- **Run the power-up diagnostics**
- **Boot the operating system**
- **Verify the system's operation over the network using the LCNODE command**
- **Run the system acceptance exerciser** (SAX)

MODULE 4

DOMAIN BRIDGE / INTERNET

AGENDA

a, DOMAIN INTERNET OVERVIEW

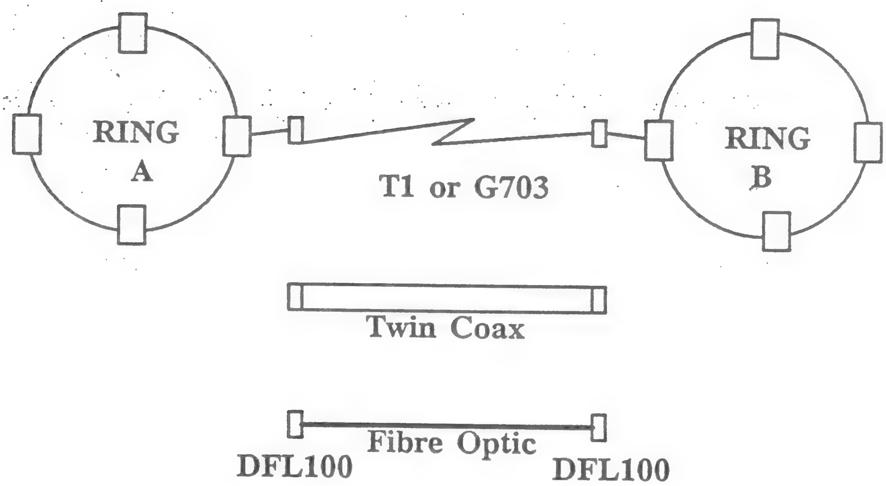
b, DOMAIN BRIDGE PRODUCTS

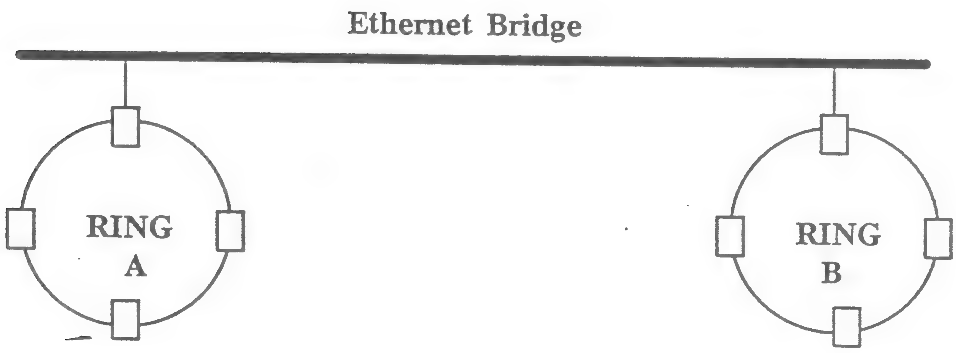
c, CONFIGURATION AND GENERAL OPERATION

DOMAIN BRIDGE

A product that connects DOMAIN networks together via

- T1 (In the U.S.) or G703 (In Europe)
- Coaxial cable
- Fibre Optic cable
- Ethernet





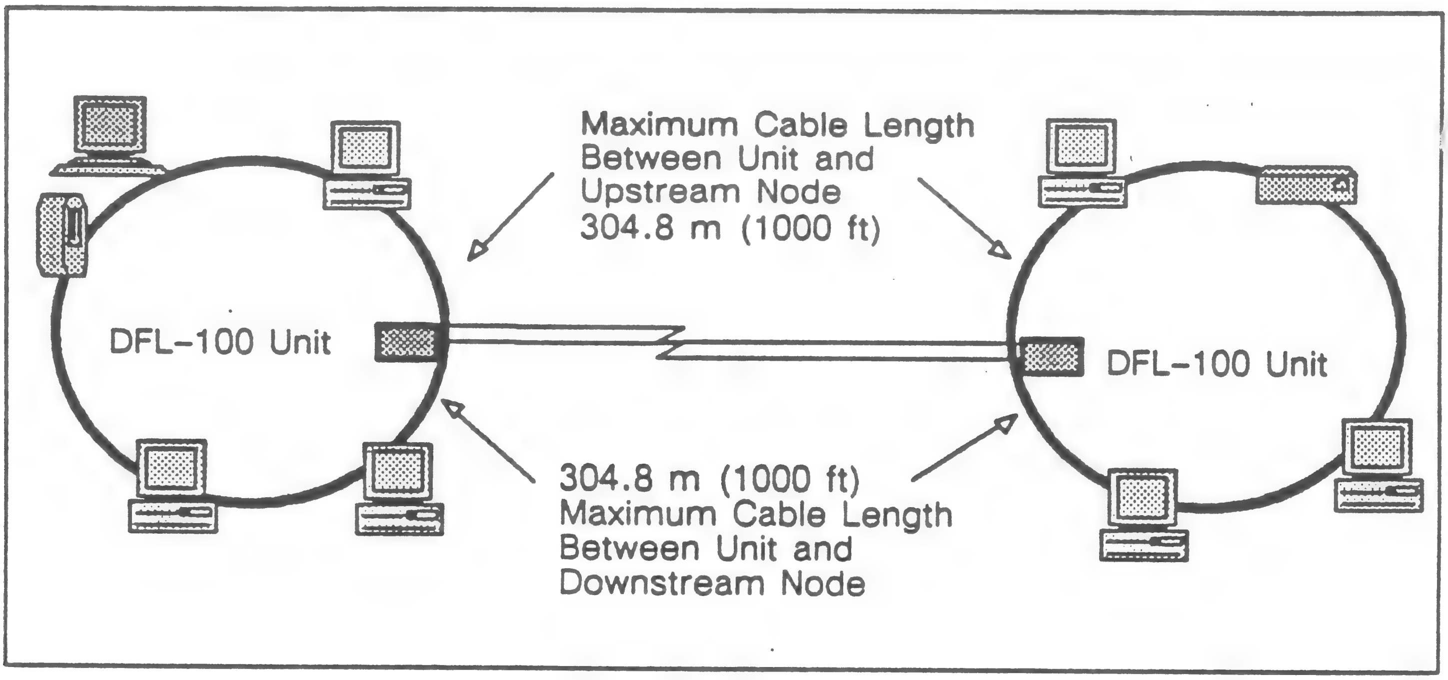


Figure 3-7. Proper Placement of DFL-100 Units

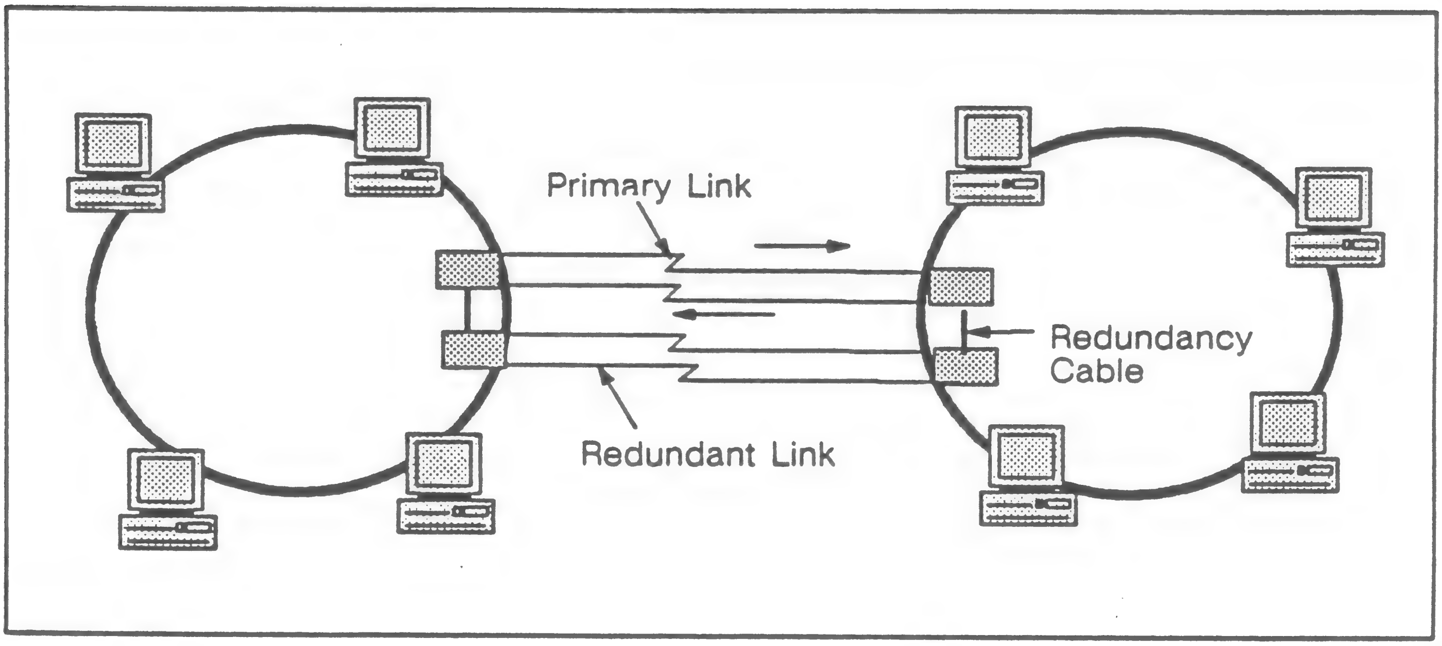
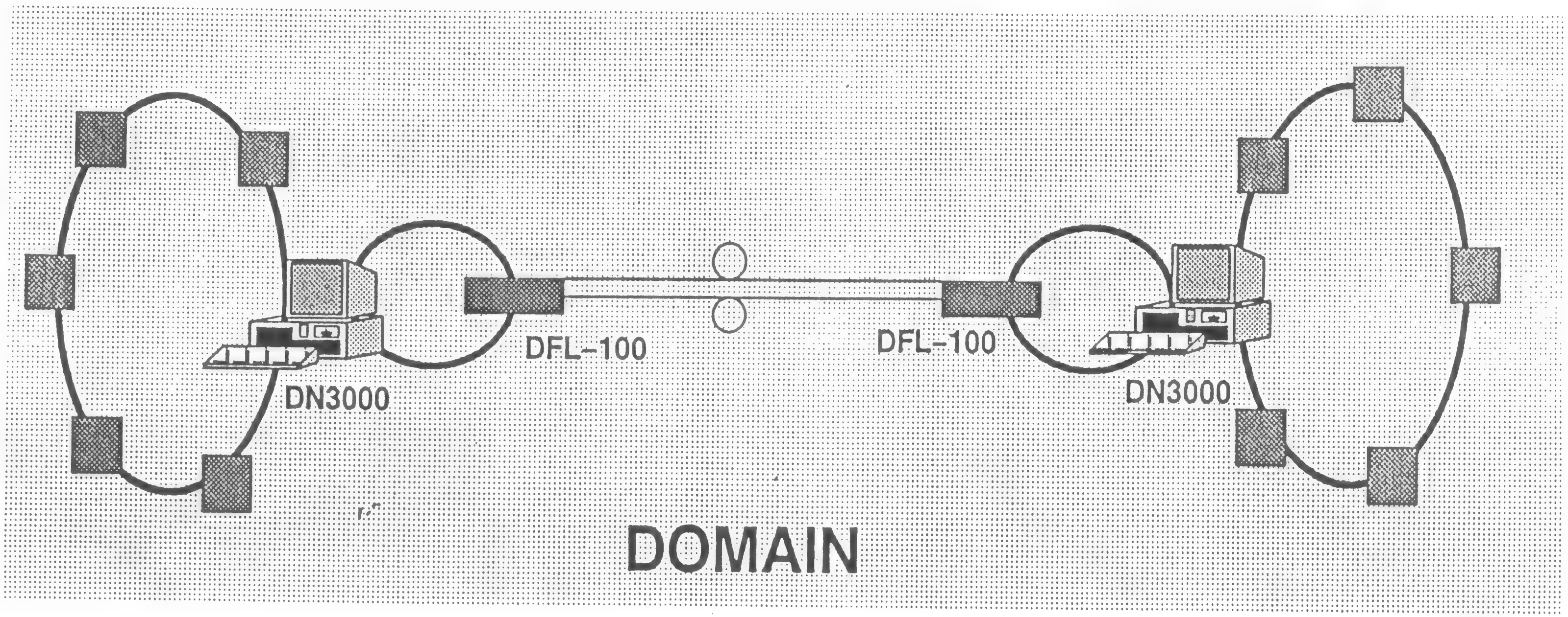


Figure 3-9. A Redundant DFL-100 Configuration



- ☞ Multiple network controller support produces many new configuration possibilities
- ☞ Here we've created a 12 Mbps fiber optic bridge between Apollo Token Ring networks

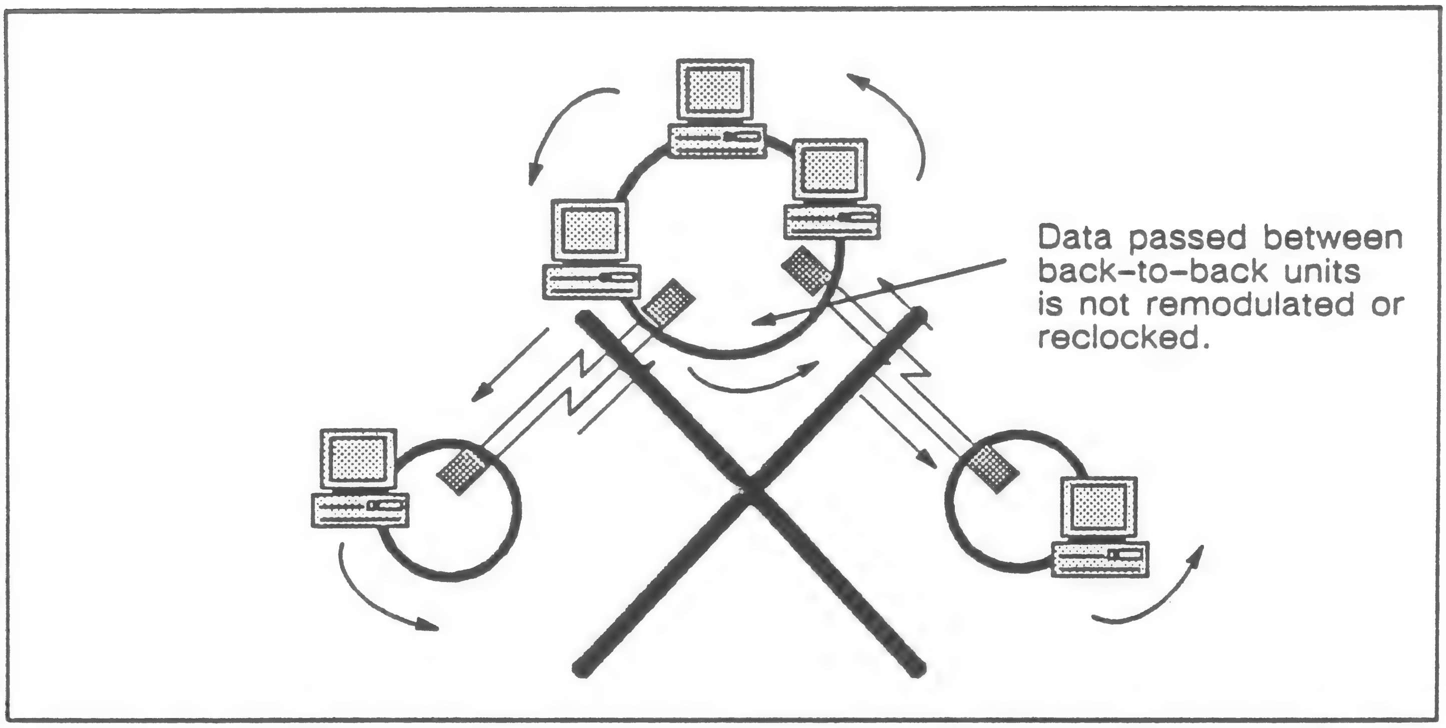


Figure 3–8. An Unacceptable Back-to-Back DFL-100 Configuration

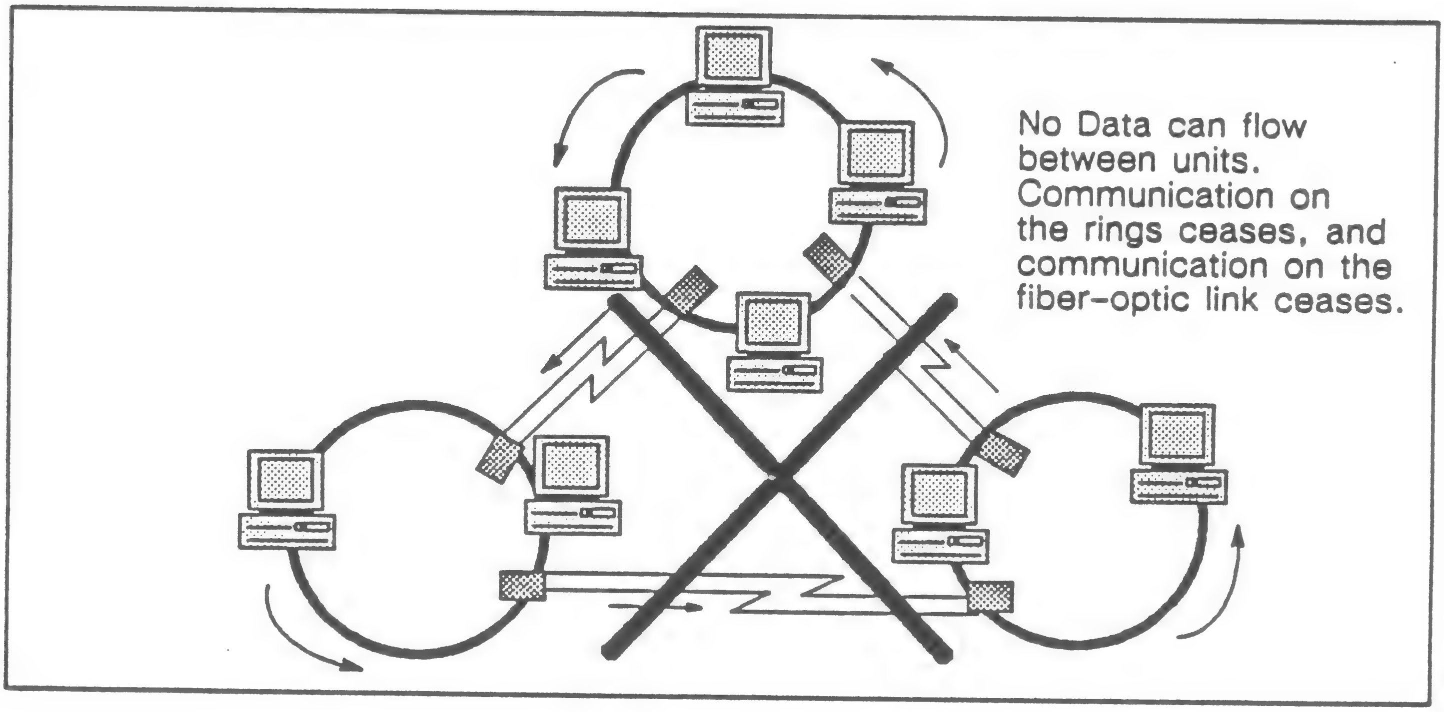
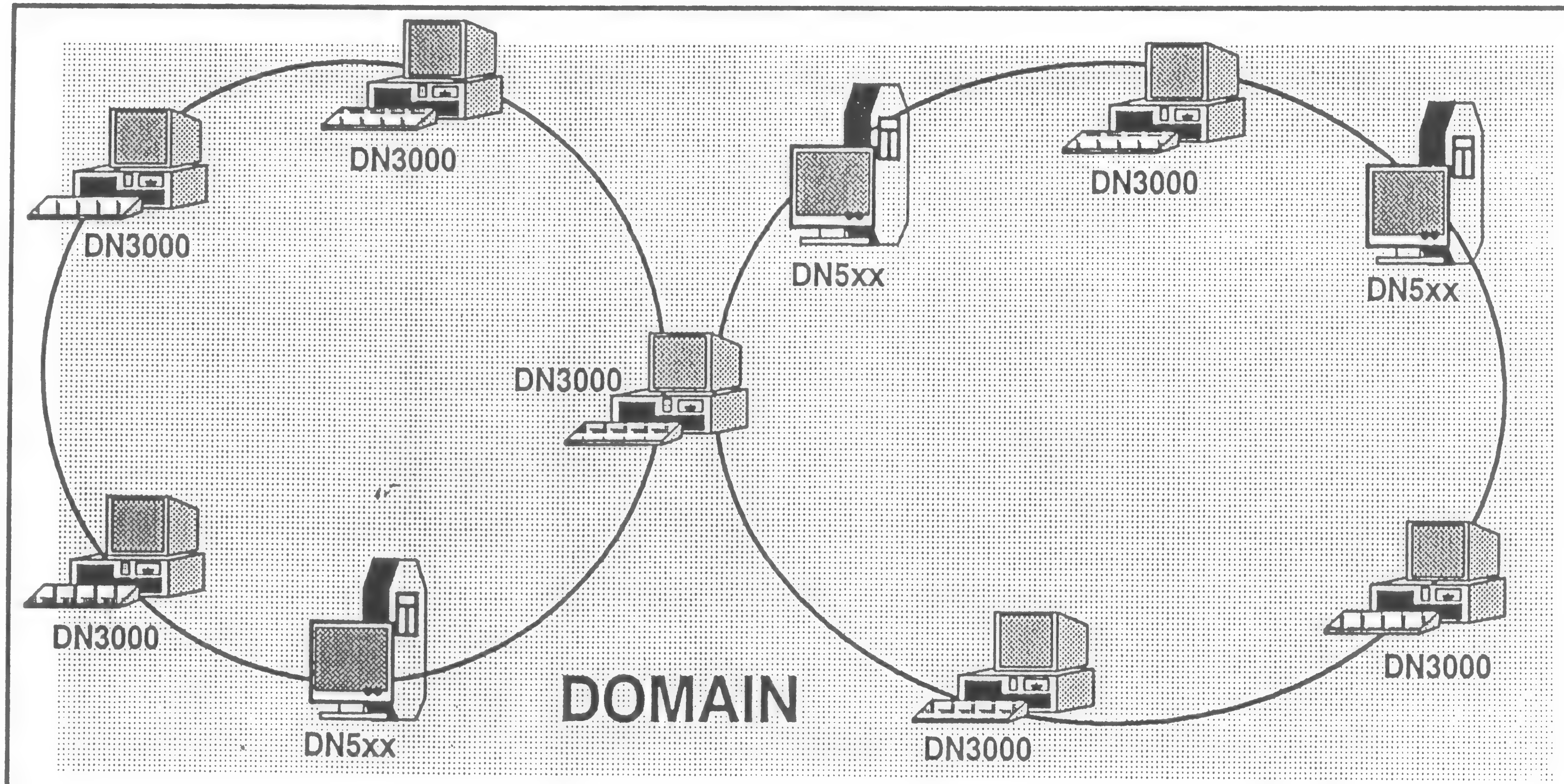
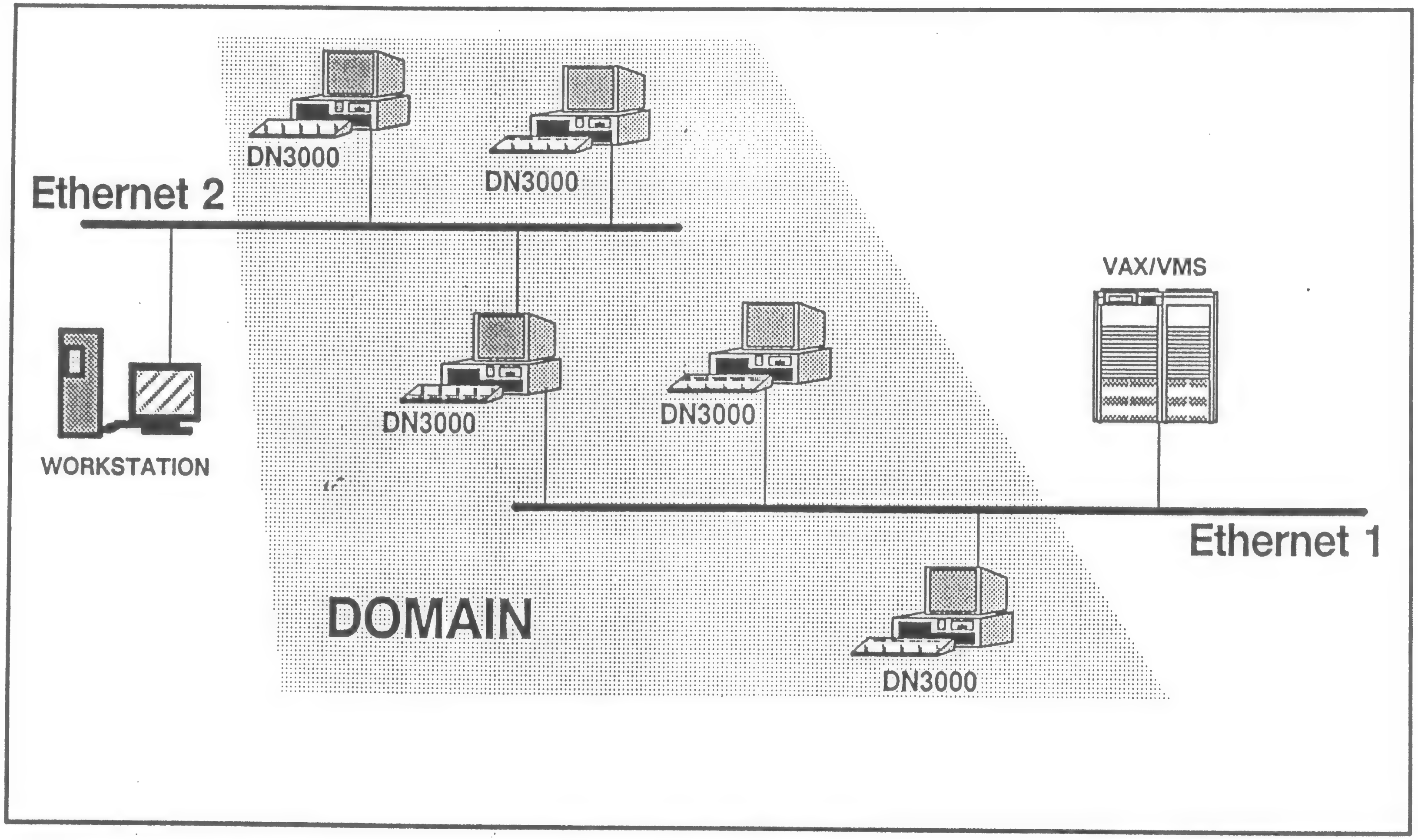


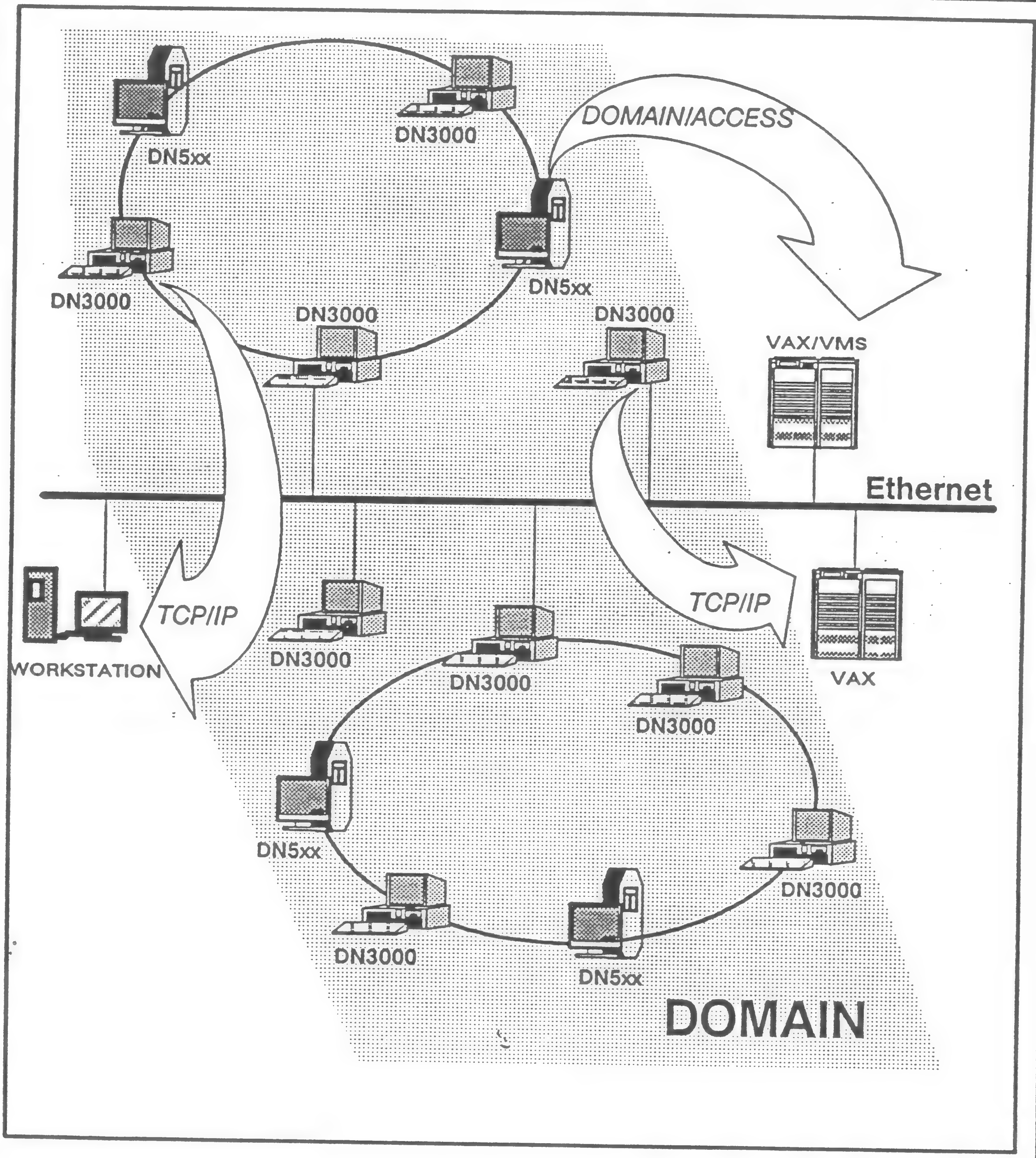
Figure 3–10. An Inoperable Redundant DFL-100 Configuration



- With two Apollo Token Ring network controllers a Series 3000 participates in two Apollo Token Ring networks
- Domain is extended across the Series 3000 bridge



- Series 3000s support multiple network controllers
- With two 802.3 Network Controller–ATs, a Series 3000 attaches to two Ethernet networks
- Domain is extended across the Series 3000 bridge



- Domain extends across all Apollo Token Ring networks and all Series 3000s attached to the Ethernet network

- All Apollo nodes can access other systems on the Ethernet network using industry standard TCP/IP protocol

ADVANTAGES OF DOMAIN/BRIDGE

CONNECT DOMAIN RINGS THAT ARE GEOGRAPHICALLY DISTANT

USERS CAN ACCESS FILES BY PATHNAME TRANSPARENTLY ACROSS CONNECTED RINGS.

GROUP NODES, MASS STORAGE DEVICES AND PERIPHERALS THAT SHARE COMMON DATA ON THE SAME RING.

HARDWARE PROBLEMS IN ONE RING DOES NOT EFFECT OTHER RINGS THEREFORE TROUBLESHOOTING IS EASIER AND LESS DISRUPTIVE.

LIMITATIONS OF DOMAIN BRIDGE

DO NOT RUN DATA INTENSIVE APPLICATIONS THAT USE DATABASES ACROSS THE BRIDGE.

DISKLESS NODES CAN NOT BOOT ACROSS THE BRIDGE.

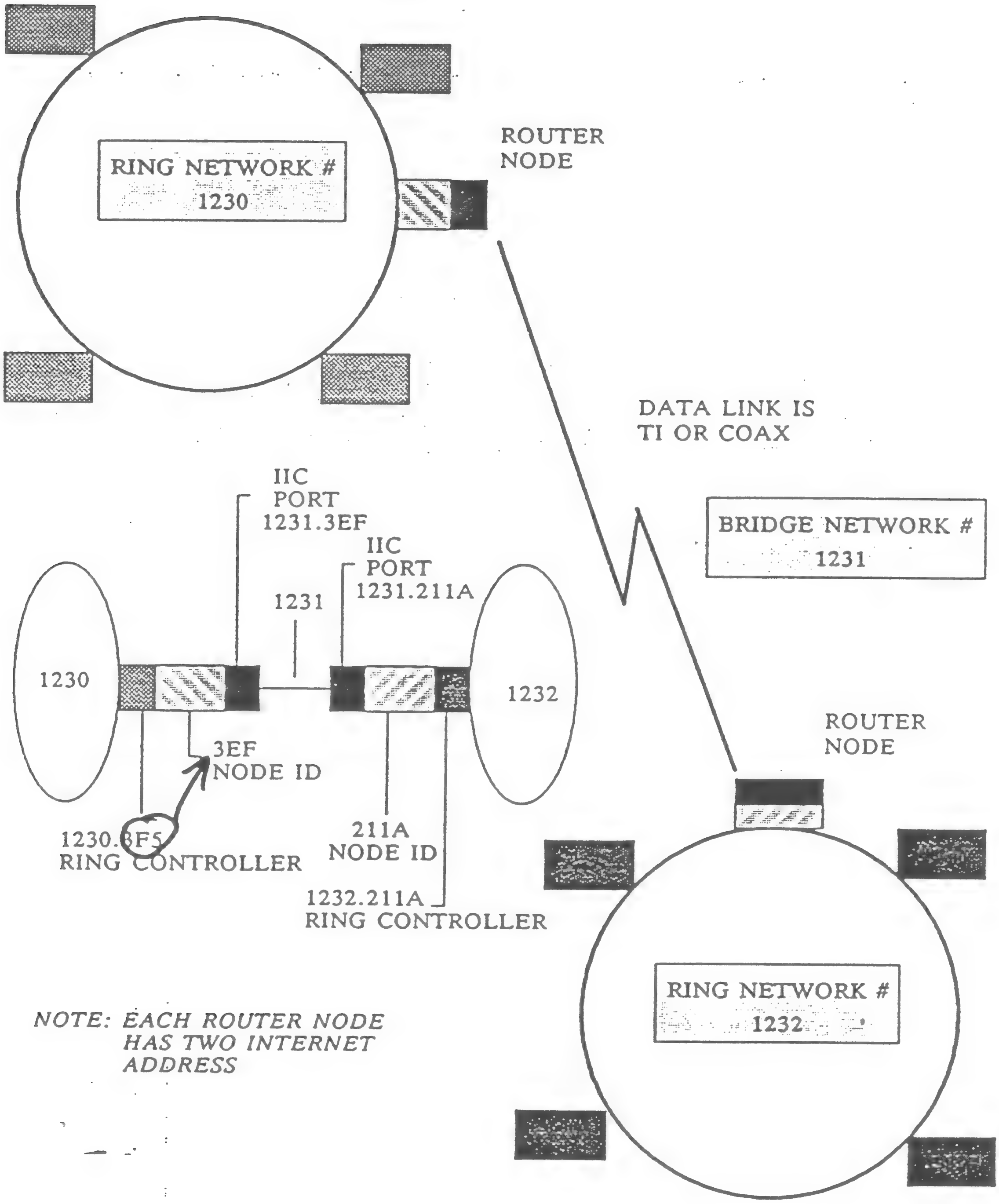
A SECURE RING AND AN OPEN RING CAN NOT BE JOINED TOGETHER. BOTH RINGS BEING JOINED MUST BE SECURE OR OPEN.

NODE NAMES MUST BE UNIQUE THROUGH OUT THE INTERNET.

ENSURE THAT EACH USER HAS A UNIQUE LOGIN NAME.

IF ROUTER NODE IS A DSP90 NO OTHER BOARDS CAN SHARE THE MULTIBUS

DOMAIN/BRIDGE NETWORK NUMBERS



NOTE: EACH ROUTER NODE HAS TWO INTERNET ADDRESS

THE SOFTWARE ROUTING PROCESS

EACH ROUTING NODE MUST BE RUNNING THE ROUTING PROCESS

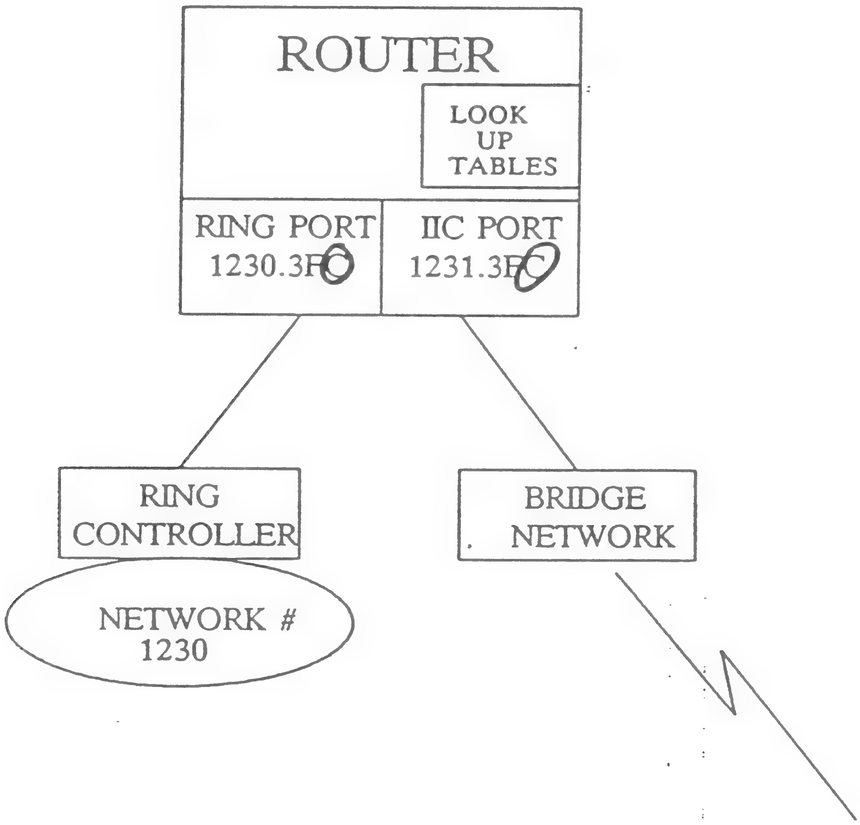
THE ROUTER MANAGES THE DATA TRANSFER ACROSS THE INTERNET TOPOLOGY

THE ROUTER SUPPLIES NONROUTING NODES WITH THE INFORMATION THEY NEED TO MAINTAIN THEIR ROUTING TABLES

PORT

THE ROUTER ACCESSES EACH NETWORK THOUGHT A SOFTWARE INTERFACE CALLED A PORT

A PORT TRANSMITS DATA TO A CONNTROLLER, WHICH THEN TRANSMITS THE DATA ONTO A NETWORK



TYPE OF NETWORK SERVICES

FULL INTERNET ROUTING SERVICES

THE CONNECTION BETWEEN THE ROUTER'S PORTS AND THEIR ASSOCIATED CONTROLLERS ARE OPEN.

A PORT CAN SEND AND RECEIVE FROM THE NODE'S OTHER PORT

SERVICES FROM THE PORTS OWN NETWORK

ONLY THE CONNECTION BETWEEN THE PORT AND THE ASSOCIATED CONTROLLER IS OPEN

THE PORT WILL NOT SEND OR RECEIVE DATA FROM THE ROUTING NODE'S OTHER PORT.

THE ROUTING NODE CAN COMMUNICATE WITH THE PORT'S NETWORK BUT CANNOT ROUTE DATA TO THE OTHER NETWORK

NO NETWORK SERVICES

THE ROUTING NODE CANNOT COMMUNICATE WITH THE PORTS NETWORK......PORT IS CLOSED

PATHNAMES IN AN INTERNET

IN AN INTERNET, PATHNAMES HAVE THE FORMAT AS IN A SINGLE RING.

FOR EXAMPLE, YOU CAN USE THE PATHNAME *//SPANKY/SYS/JUNK* REGARDLESS OF THE RING WHERE THE FILE IS LOCATED.

LINKS CAN ALSO BE USED TO SPECIFY OBJECTS ANYWHERE IN THE INTERNET.

REF AYDBI P 1–2

NS_HELPER

RESOLVES PATHNAMES FOR OBJECTS ON REMOTE RINGS

MUST RUN AT LEAST ONE *NS_SERVER* ON EACH RING

NS_SERVER MAINTAINS AN INTERNET WIDE NAMING DATABASE.

DATABASE CONTAINS THE INFORMATION A NODE NEEDS TO KNOW TO FIND AN OBJECT ANYWHERE IN THE INTERNET

NS_HELPER

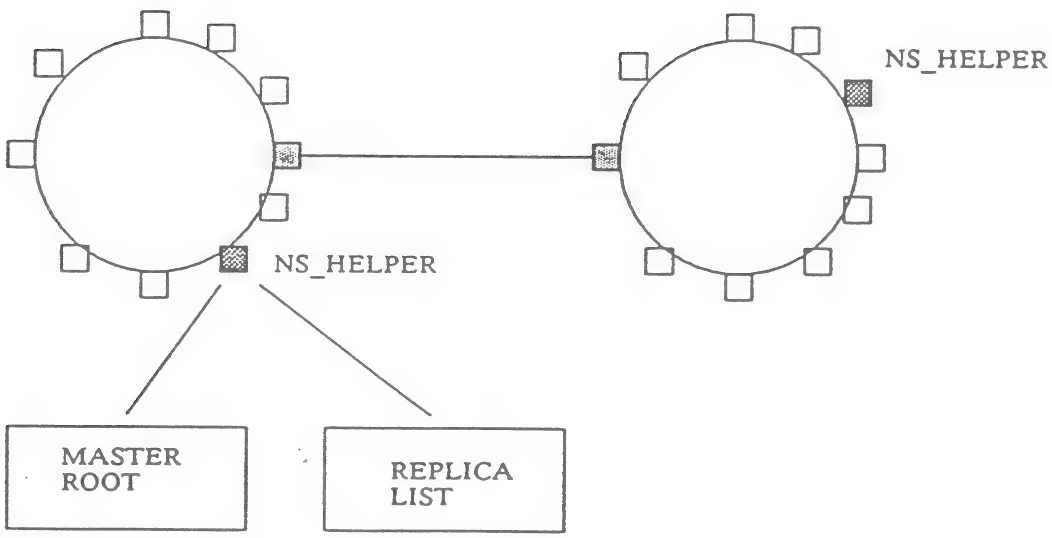
NS_HELPER CONTAINS TWO PARTS:

MASTER ROOT DIRECTORY

ALL NODES INTERNET ADDRESSES

REPLICA LIST

INTERNET ADDRESS OF ALL *NS_HELPERS*



NODE SPECIFICATIONS IN INTERNET

INTERNET ADDRESS HAS THE FORMAT:

[NET].NODE_ID

IF NS_HELPER CATALOGED THE NODE CALLED DAISY WITH THE ID OF A2B2 THEN THE FOLLOWING COMMAND COULD BE EXECUTED.

$LUSR –N A2B2

$LUSR –N //DAISY

$LUSR –N 1230.A2B2

$LUSR –N 0.A2B2

SHELL COMMANDS

THE FOLLOWING COMMANDS COLLECT INFORMATION ONLY IN THE LOCAL RING THEY HAVE BEEN EXECUTED.

BLDT

CTNODE

LCNODE *NO OPTIONS*

LUSR *NO OPTIONS*

LVOLFS –A

NETSTAT –A

PROBENET –A

Managing the environment in a Domain internet

Checklist for Starting the Routing Process

bguerandering naam
internet

dlf 'node_data/ns_?*
" 'node_data/hint_file

Use this checklist to track your progress as you perform the tasks described in Chapter 3.

	Task	Page
☐	1. *Confirm the router's device configuration*	3–2
☐	2. *Confirm the router's network configuration*	3–3
☐	3. *Power down diskless routing nodes*	3–5
☐	4. *Change command search rules*	3–5
☐	5. *Assign principal network number*	3–5
☐	6. *Delete the routing node's hint file*	3–6
☐	7. *Reboot routing nodes*	3–6
☐	8. *Verify the router's principal network number*	3–6
☐	9. *Assign alternate network number*	3–6
☐	10. *Start the routing process*	3–7
☐	11. *Restore command search rules*	3–8
☐	12. *Verify router communication*	3–8
☐	13. *Verify nonrouting node communication*	3–8
☐	14. *Create routing start–up files*	3–9
☐	15. *Verify routing start–up files*	3–9

Checklist for Creating an Internet

Use this checklist to track your progress as you perform the tasks described in Chapter 4.

	Task	Page
❑	*16. Synchronize node clocks*	*4–1*
❑	*17. Restart server processes*	*4–2*
❑	*18. Prepare nodes for ns_helper replicas*	*4–2*
❑	*19. Initialize replicas*	*4–3*
❑	*20. Compare replica databases*	*4–4*
❑	*21. Merge replica databases*	*4–6*
❑	*22. Change duplicate node names*	*4–7*
❑	*23. Verify master root directory*	*4–7*
❑	*24. Create names for diskless nodes*	*4–8*
❑	*25. Compare PPO files*	*4–10*
❑	*26. Fix local registries*	*4–11*
❑	*27. Compare Account files*	*4–11*
❑	*28. Merge registries*	*4–14*
❑	*29. Flush local naming caches*	*4–15*
❑	*30. Update node copies of registry*	*4–16*
❑	*31. Restart mbx_helper and spm*	*4–16*

MODULE 5

TCP/IP

I. OVERVIEW OF TCP/IP PRODUCTS AND THEIR RELATIONSHIP
   A. TCP/IP Based Software
   B. Ethernet Gateways
   C. Software on Remote Hosts

II. Introduction to TCP/IP Communications
   A. Internet
   B. OSI Model
   C. Gateway
   D. Internet Routing
   E. DOMAIN Bridges as Gateways
   F. Internet Address

III. TCP/IP Configuration
   A. Gateway Names and Address
   B. Phyiscal Layer Interface Descriptions
   C. TCP/IP Servers
   D. Administration Nodes
   E. Links and File Locations
   F. TCP/IP ADMIN NODE CONFIG FILES
   G. Defining Mapping Files
   H. TCP/IP Headers

IV. BSD4.2 TCP/IP Configuration
   A. Creating TCP/IP Environment
   B. BSD4.2 Daemons
   C. Links and File Locations
   D. DOMAIN/IX FILES

V. LAB

TCP/IP VERSIONS

TCP Version 2.1 or 2.2 — SR9.2 (bundled product)

All inclusive package

Defined: Host/Client
Admin Node
Gateway Node
MB Driver Software

Three Versions
Aegis TCP/IP G/W
BSD4.2 TCP/IP (on-ring)
BSD4.2 TCP/IP G/W

Only supported Multibus version of hardware

TCP Version 3.0 — SR9.5.1 (unbundled)

Defines: Host/Client node
Admin Node
Gateway Node

Three Versions
AEGIS TCP/IP G/W
BSD4.2 TCP/IP (on-ring)
BSD4.2 TCP/IP G/W

Hardware and Driver S/W
Multibus-- ECMB Ver 2.0 (Driver)
AT Bus-- A_ADD_ETH (Board): ECAT Ver 2.0 (Driver)

TCP Version 3.0 — SR9.6 (unbundled)

Defines: Host/Client
Admin Node
Gateway Node

Three Versions
AEGIS TCP/IP G/W
BSD4.2 TCP/IP (on-ring)
BSD4.2 TCP/IP G/W

Hardware and Driver S/W
Multibus -- ECMB Ver 2.0 (Driver)
AT BUS -- A_NET_ETH (Board); Driver software included in O/S

TCP Version 3.1 — SR9.7 (unbundled)

Defines: Host/Client
Admin Node
Gateway Node

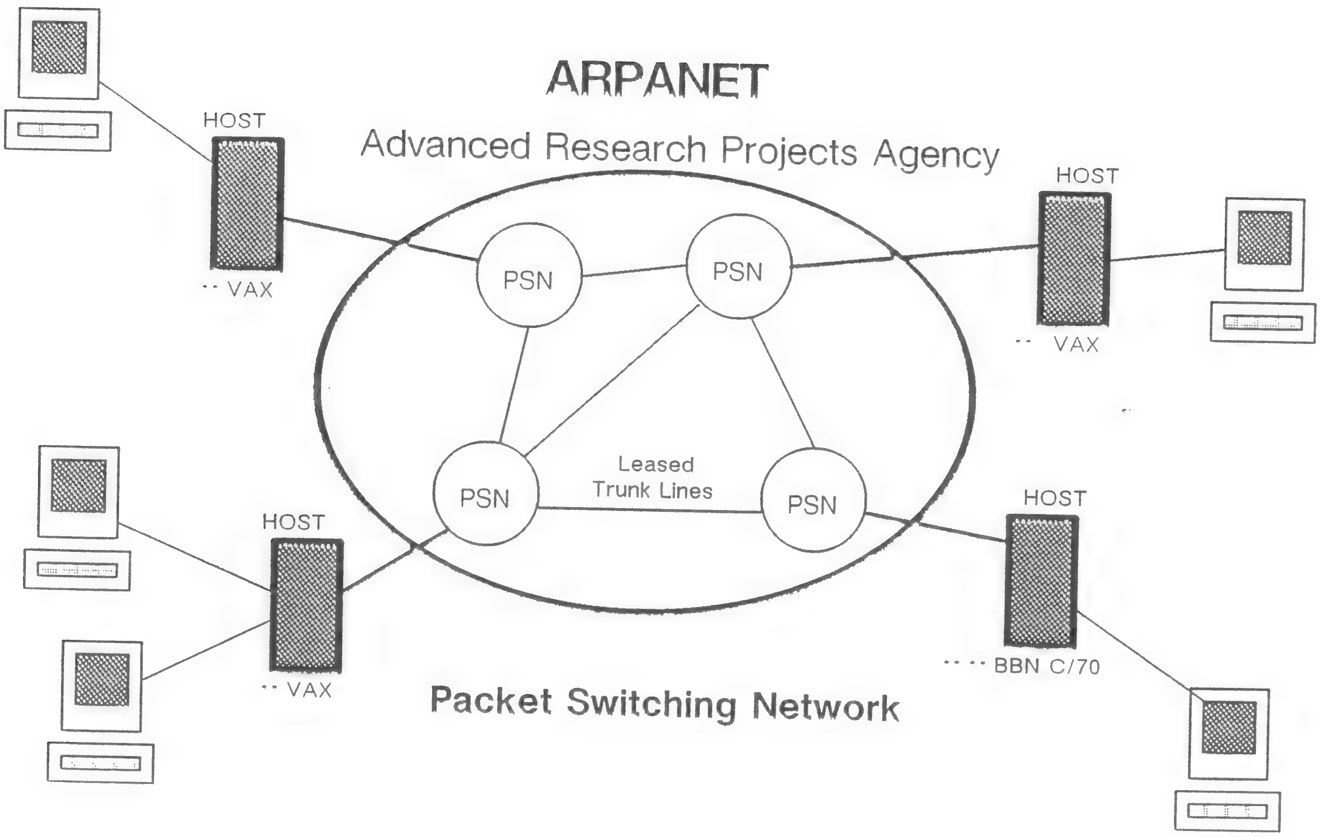
One Version
Both AEGIS and
BSD4.2 TCP/IP G/W

Hardware and Driver S/W
Multibus -- ECMB Ver 2.0 (Driver)
AT BUS -- A_NET_ETH (Board); Driver software included in O/S

SECTION I

OVERVIEW OF TCP/IP PRODUCTS AND THEIR RELATIONSHIP

Department of Defense
(DoD)



PSN – Packet Switching Node

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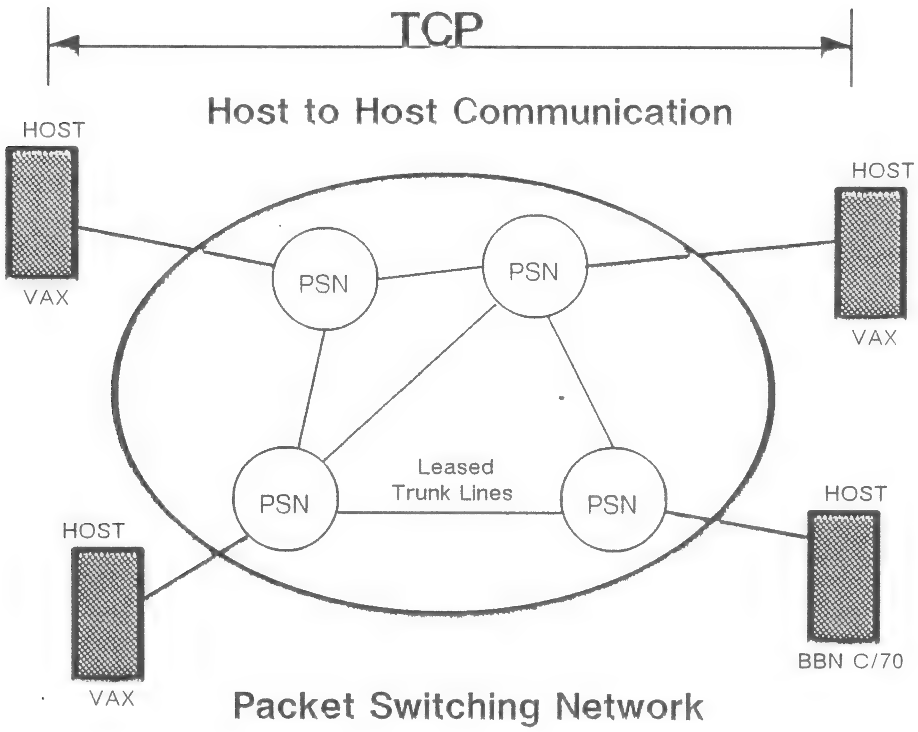
**** BBN C/70 is a registered trademark/copyright of Bolt, Beranek, and Newman Corporation.

Transmission Control Protocol



Lower level protocols such as X.25, HDLC, RS-232-C, etc. are responsible for moving data from source host connection to destination host connection.

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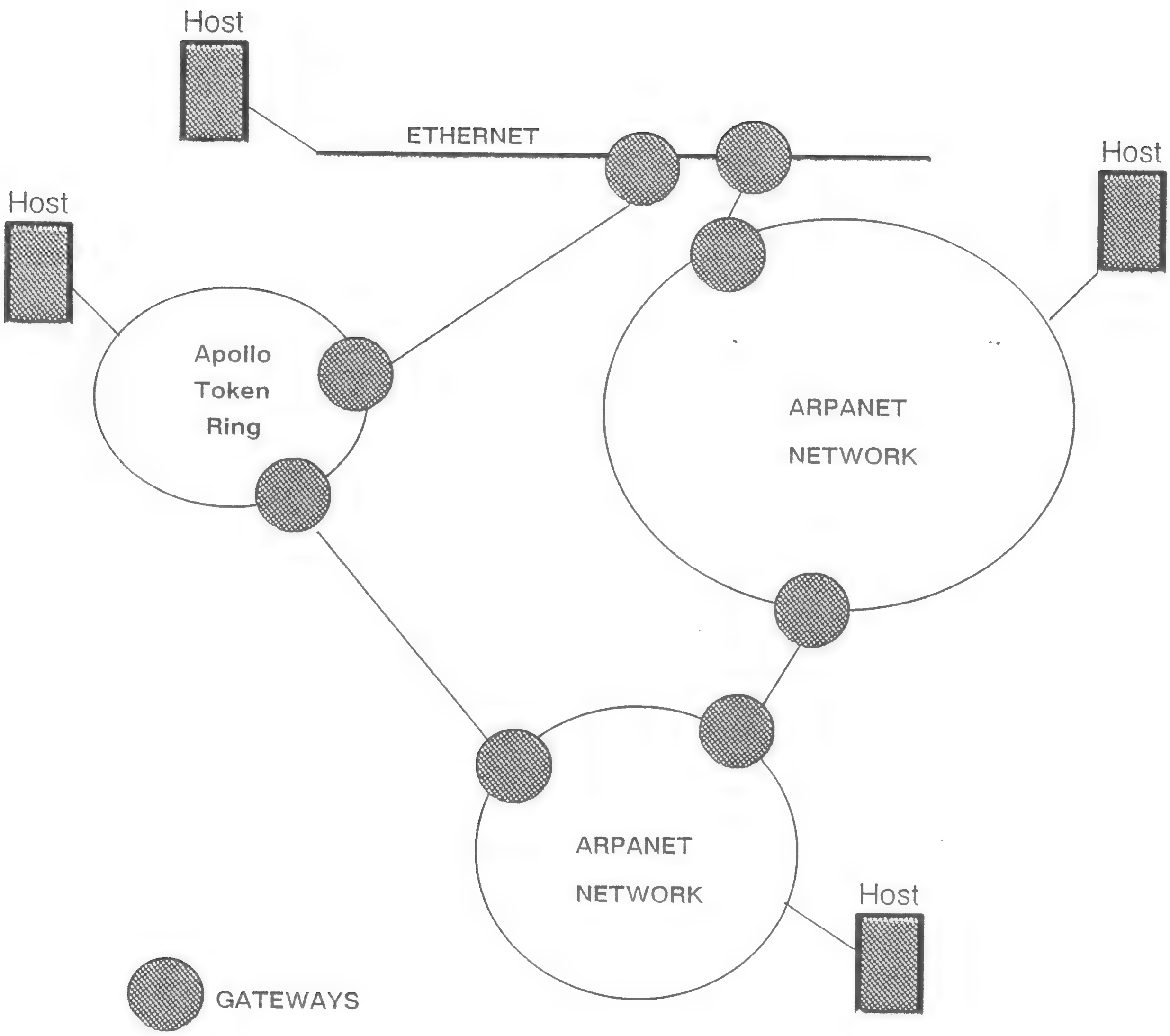
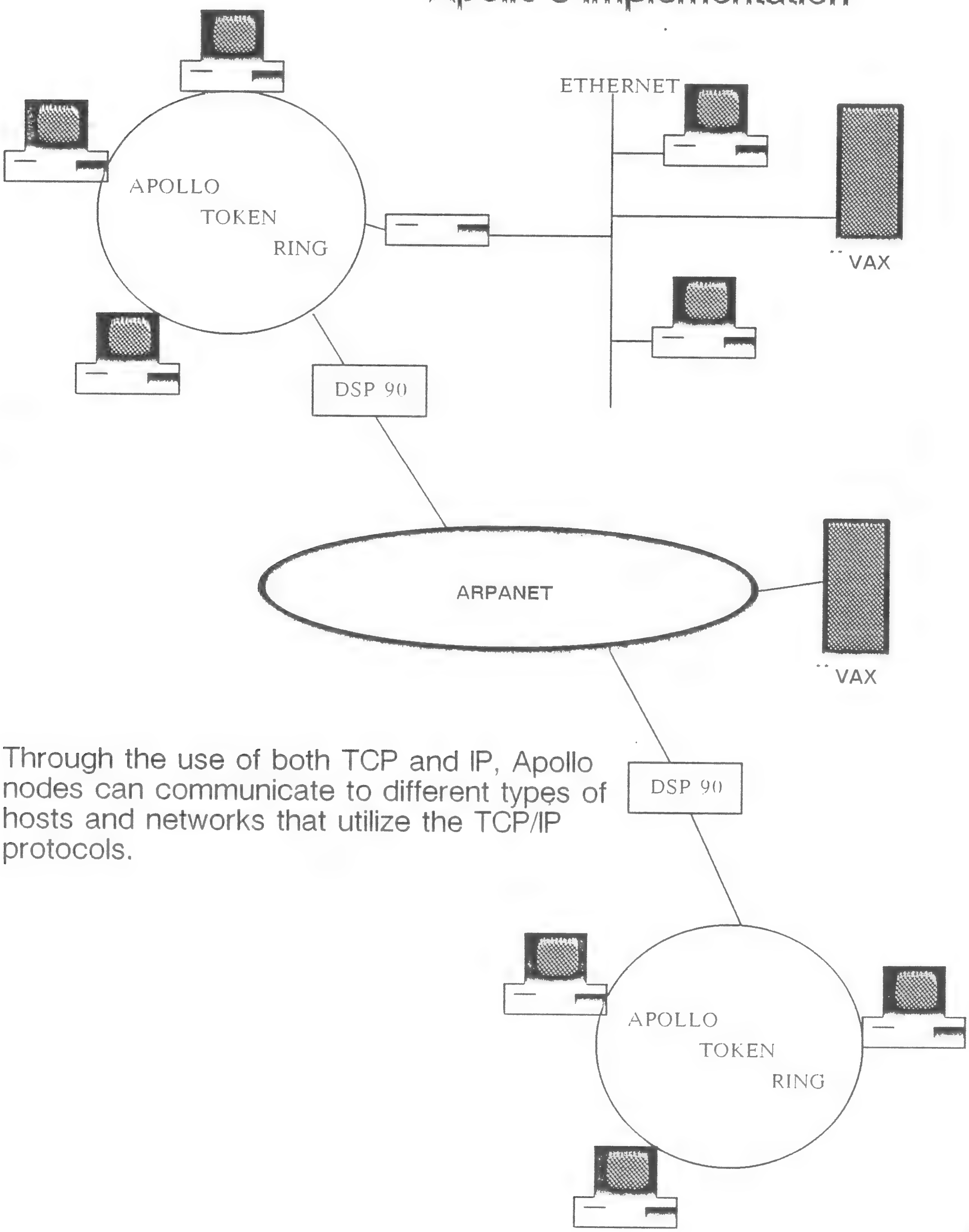
IP

INTERNET PROTOCOL

Handles routing of data between networks



Apollo's Implementation



Through the use of both TCP and IP, Apollo nodes can communicate to different types of hosts and networks that utilize the TCP/IP protocols.

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TCP/IP BASED SOFTWARE

THREE DOMAIN TCP/IP–BASED SOFTWARE PACKAGES ARE CURRENTLY AVAILABLE

DOMAIN TCP/IP COMMUNICATIONS

DOMAIN/IX BSD4.2 TCP/IP COMMUNICATIONS

DOMAIN/IX BSD4.2 GATEWAY COMMUNICATION
Domain/Access.

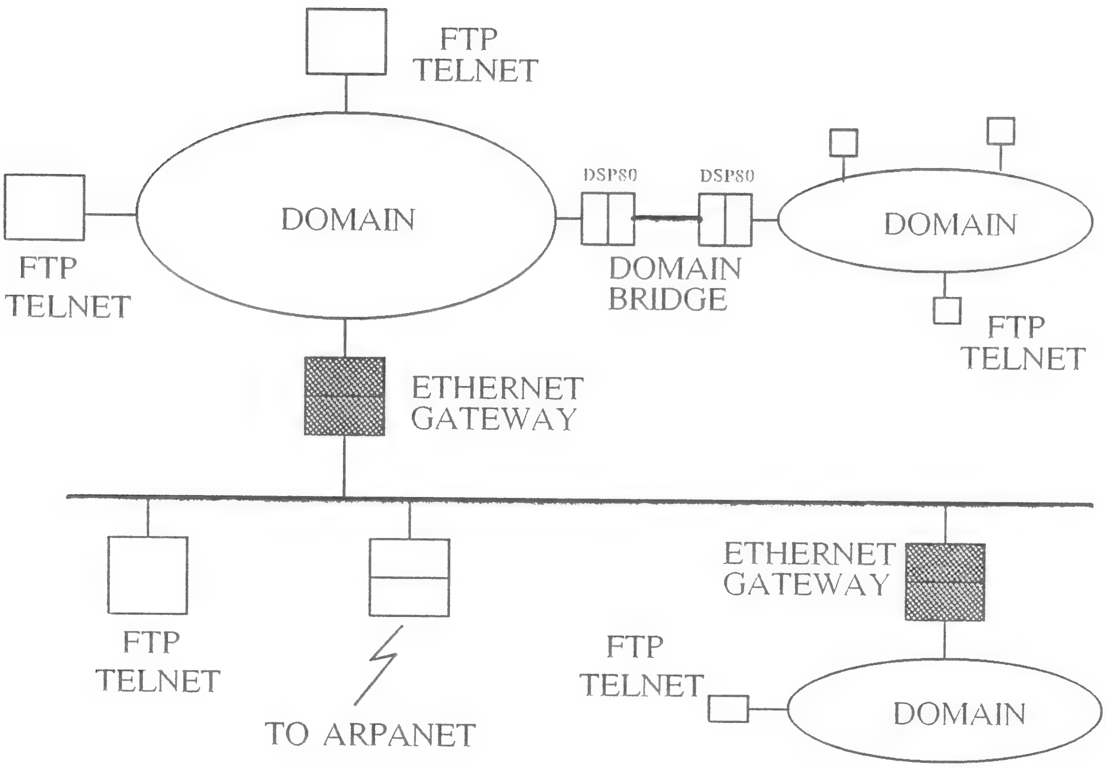
DOMAIN TCP/IP

COMMUNICATES WITH SYSTEMS THAT USE THE DARPA-STANDARD FTP AND TELNET PROTOCOL ON:

DOMAIN NETWORKS

ETHERNET LOCAL AREA NETWORKS

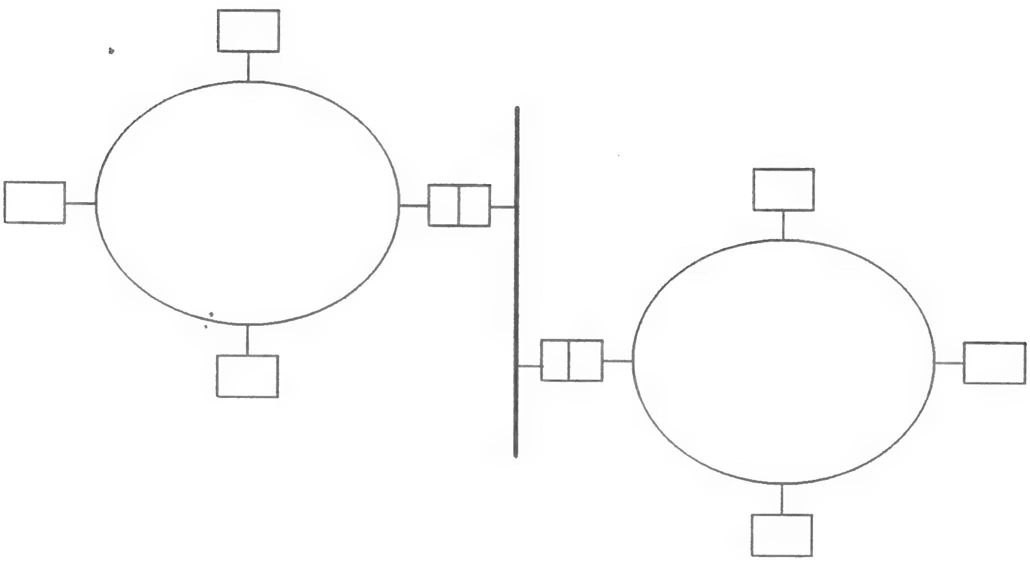
OTHER NETWORKS CONNECTED THROUGH THE ETH ERNET.



DOMAIN/IX BSD4.2 TCP/IP

BSD4.2 ALLOWS COMMUNICATIONS WITH OTHER BSD4.2 SYSTEMS ON THE DOMAIN NETWORK OR ON A CONNECTED ETHERNET NETWORK. THE UTILITIES INCLUDE:

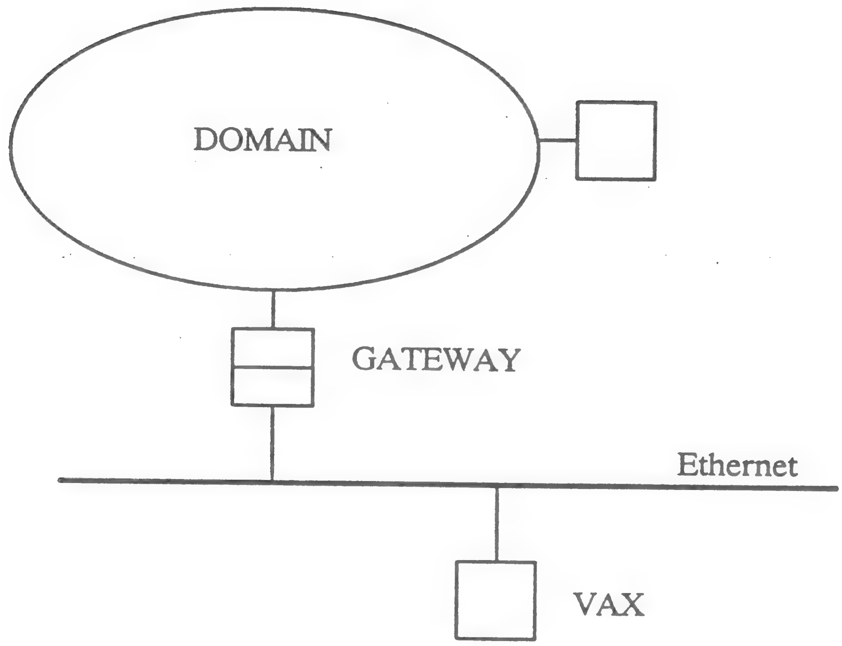
FTP	LPR
RCP	REXEC
RLOGIN	RSH
TELNET	RWHO



NOTE: DOMAIN/IX BSD4.2 TCP/IP software is a standard part of the DOMAIN/IX BSD4.2 product. However DOMAIN/IX BSD4.2 does not include the gateway and interface software and hardware required to access hosts on other networks (the ethernet controller board and gateway software).

DOMAIN ACCESS

PROVIDES TRANSPARENT ACCESS TO VAX/VMS FILES AS IF THEY WHERE PART OF THE DOMAIN FILE SYSTEM.



Techniek voor comm. met vax.

SOFTWARE REQUIRED ON REMOTE HOSTS

REMOTE SYSTEMS MUST HAVE DARPA–COMPATABLE TCP/IP SOFTWARE TO COMMUNICATE WITH DOMAIN TCP/IP.

COMPUTERS THAT RUN STANDARD BSD4.2 UNIX USUALLY SUPPORT TCP/IP AND THE BSD4.2 INTERNET UTILITIES THAT ARE SUPPORTED BY DOMAIN/IX.

SECTION II

INTRODUCTION TO TCP/IP COMMUNICATIONS

INTERNET

AN INTERNET IS A COLLECTION OF DIFFERENT CONNECTED NETWORKS THAT COMMUNICATE WITH ONE ANOTHER.

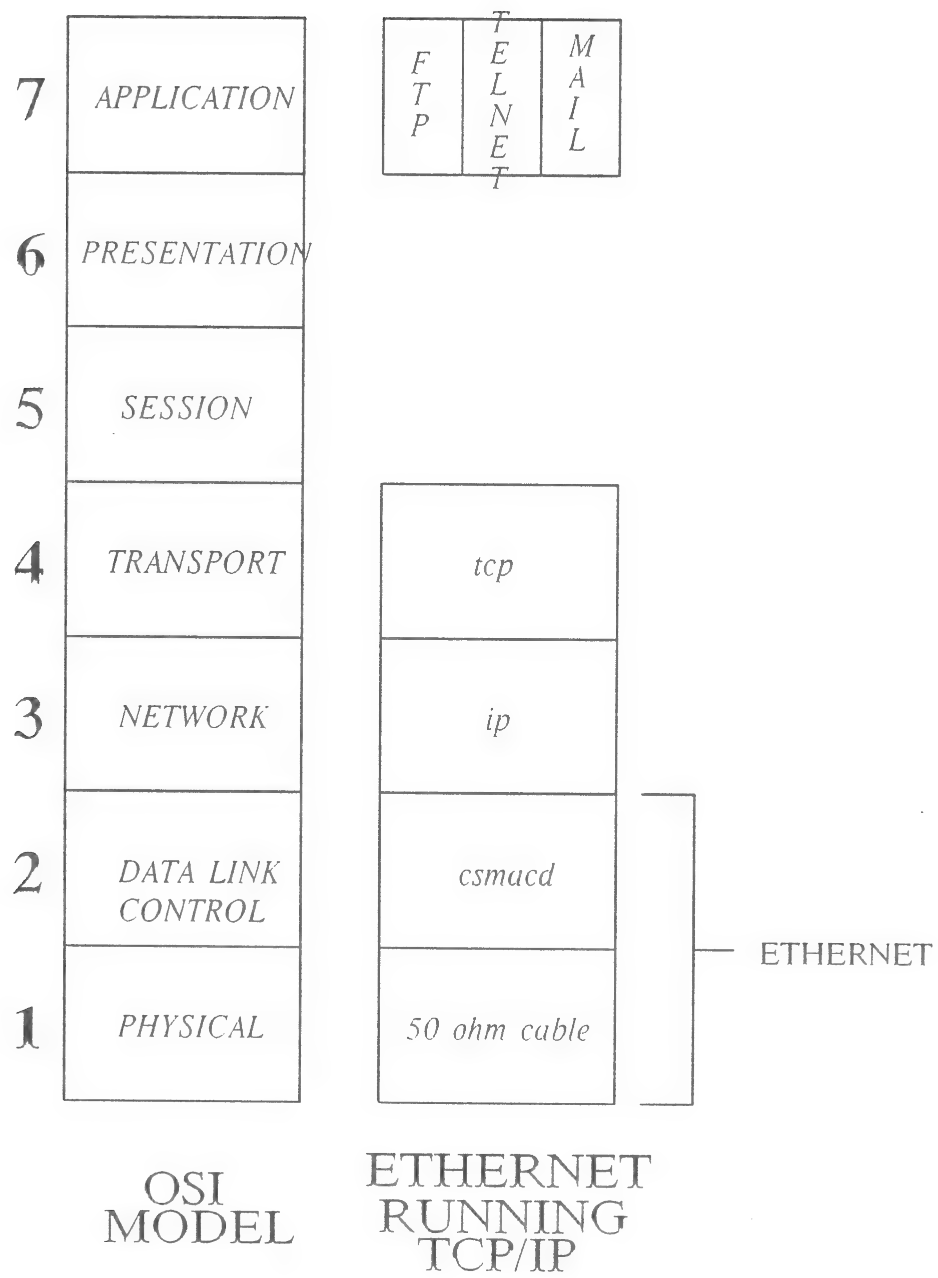
AN *INTERNET MODEL* IS A SET OF PROTOCOLS THAT ENABLE INTER–NETWORK COMMUNICATIONS

TCP/IP ARE JUST TWO COMPONENTS OR PROTOCOLS OF A SPECIFIC INTERNET MODEL DEFINED BY *DARPA* (DEFENSE ADVANCED REASEARCH PROJECTS AGENCY)

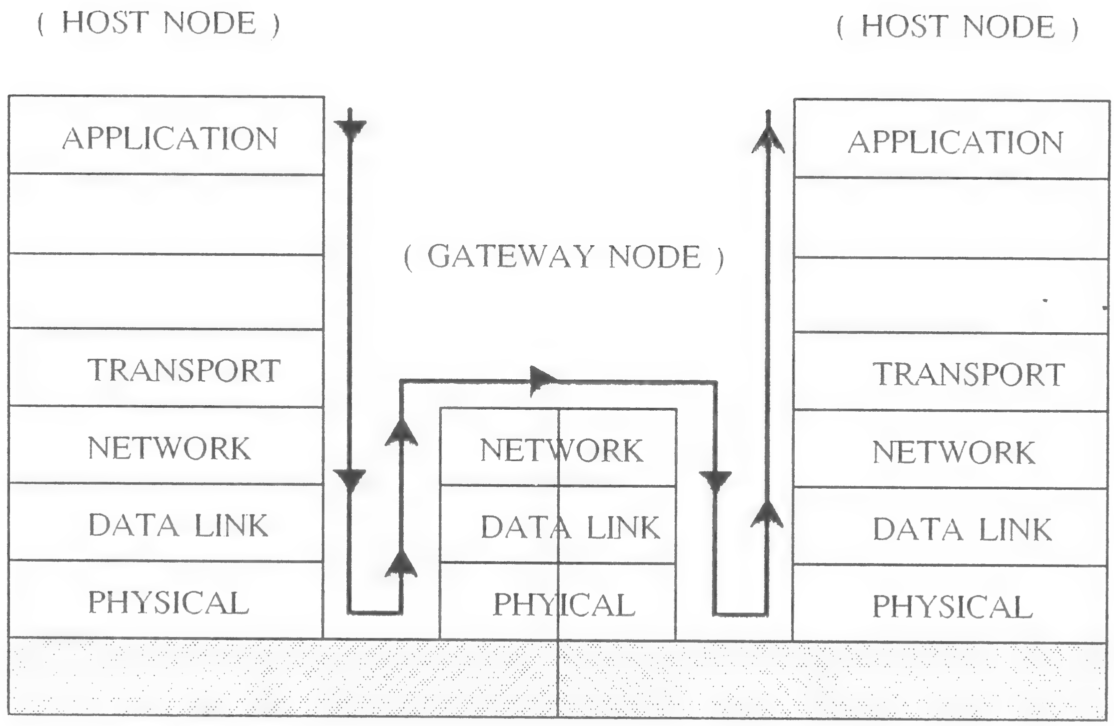
NIC (NETWORK INFORMATION CENTER) MAINTAINS DETAILED INFORMATION ABOUT THE *INTERNET MODEL*

SRI INTERNATIONAL
MENLO PARK, CA 94025

THE OSI MODEL

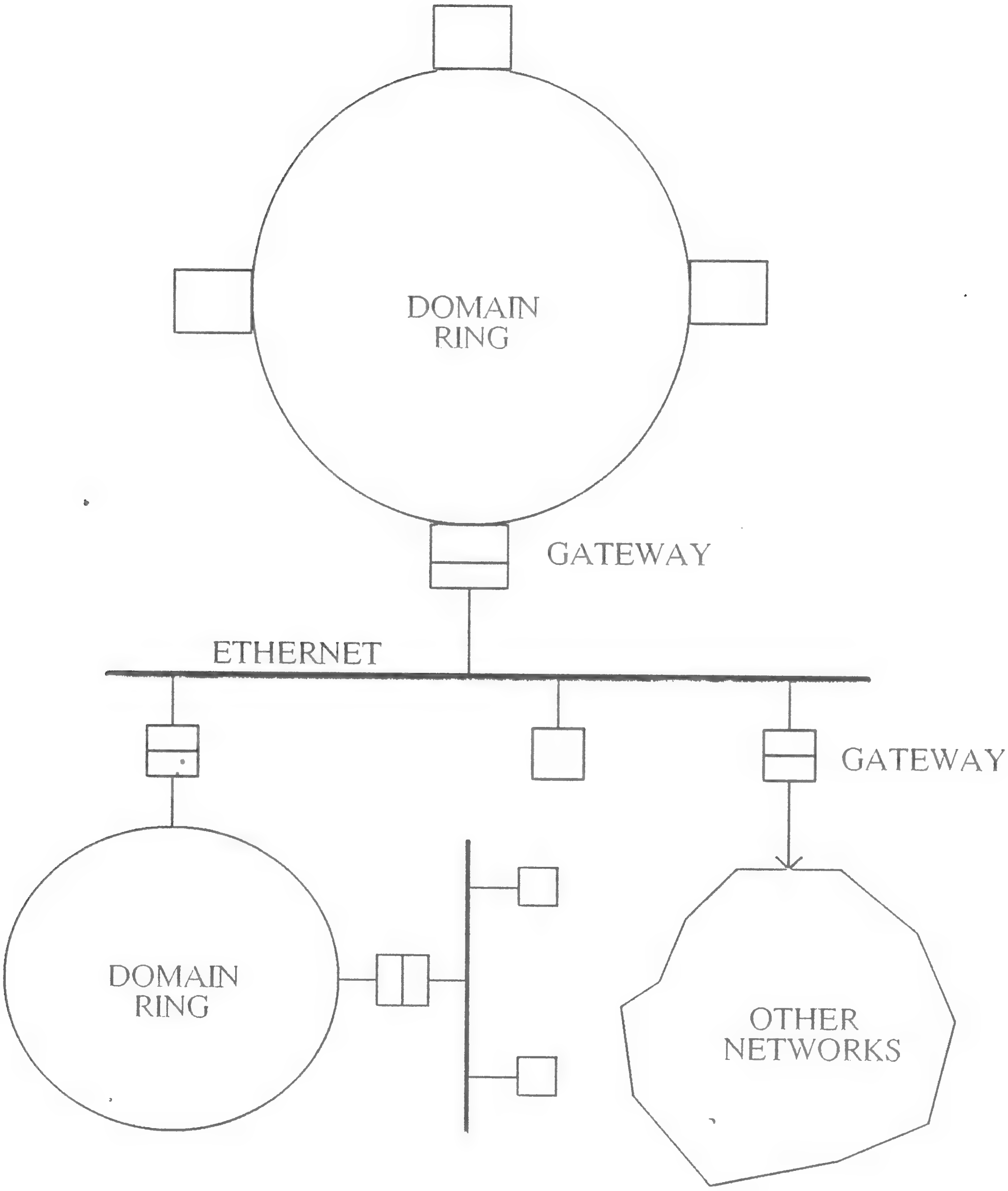


INTERNET GATEWAYS

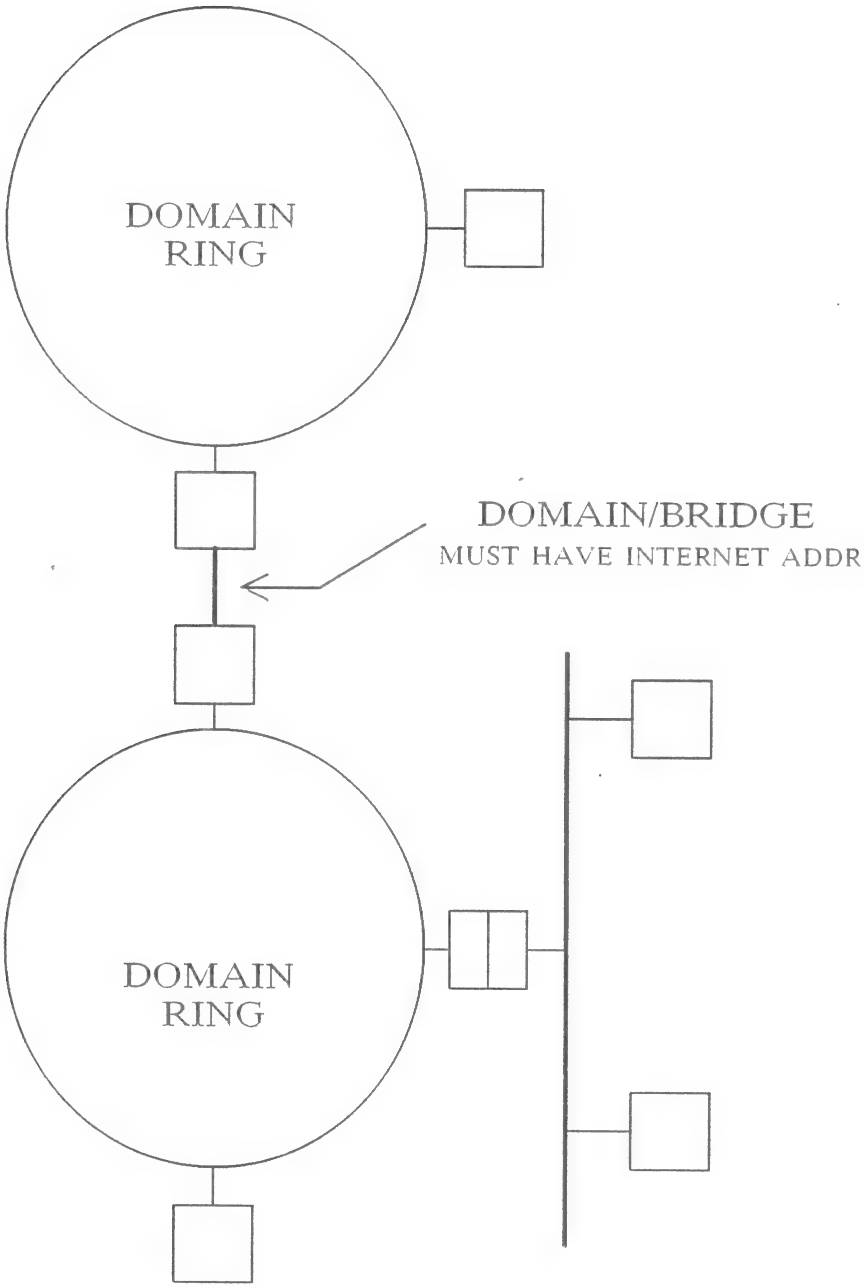


INTERNET ROUTING, THE SOFTWARE POINT OF VIEW.

INTERNET ROUTING



DOMAIN BRIDGES AS GATEWAYS



INTERNET ADDRESS FORMAT

TYPE A

0	7 BITS	8 BITS	8 BITS	8 BITS

MAXIMUM NUMBER OF NETWORKS = 126
MAXIMUM NUMBER OF HOSTS = 16,777,214

1.0.0.1 TO 126.255.255.254

TYPE B

10	6 BIT	8 BITS	8 BITS	8 BITS

MAXIMUM NUMBER OF NETWORKS = 16,384
MAXIMUM NUMBER OF HOSTS = 65,535

128.1.0.1 TO 191.254.255.254

TYPE C

110	5BIT	8 BITS	8 BITS	8 BITS

MAXIMUM NUMBER OF NETWORKS = 2,097,152
MAXIMUM NUMBER OF HOSTS = 254

192.0.1.1 TO 223.225.254.254

NOTE: ADDRESSES OF ALL ONES OR ZERO ARE RESERVED

NETWORK ADDR RANGE

223.255.254 – 192.0.1	C
191.254 – 128.1	B
126 – 1	A

POSITIONAL WEIGHT

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1

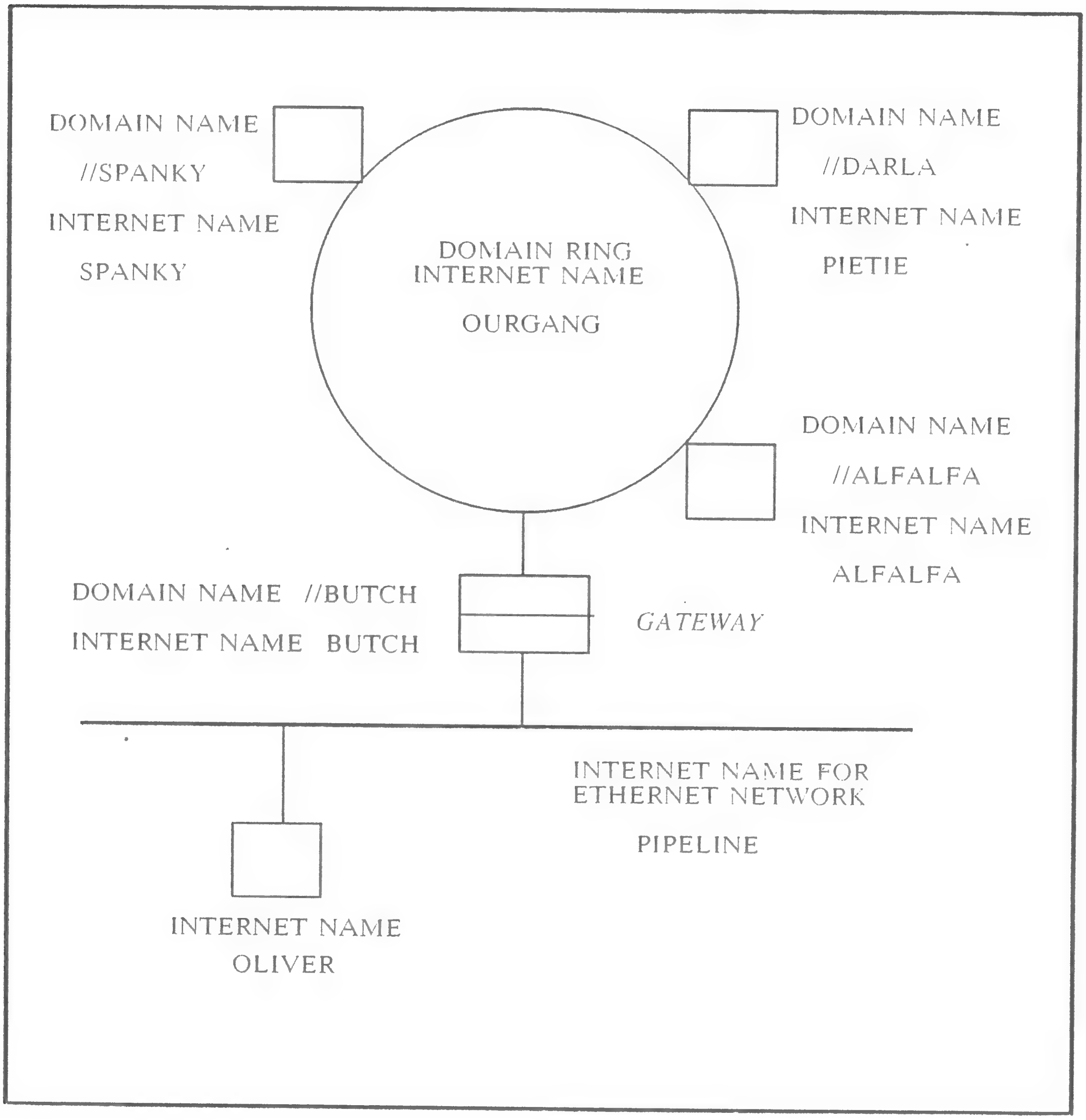
▒ =NETWORK ADDR

SECTION III

TCP/IP CONFIGURATION

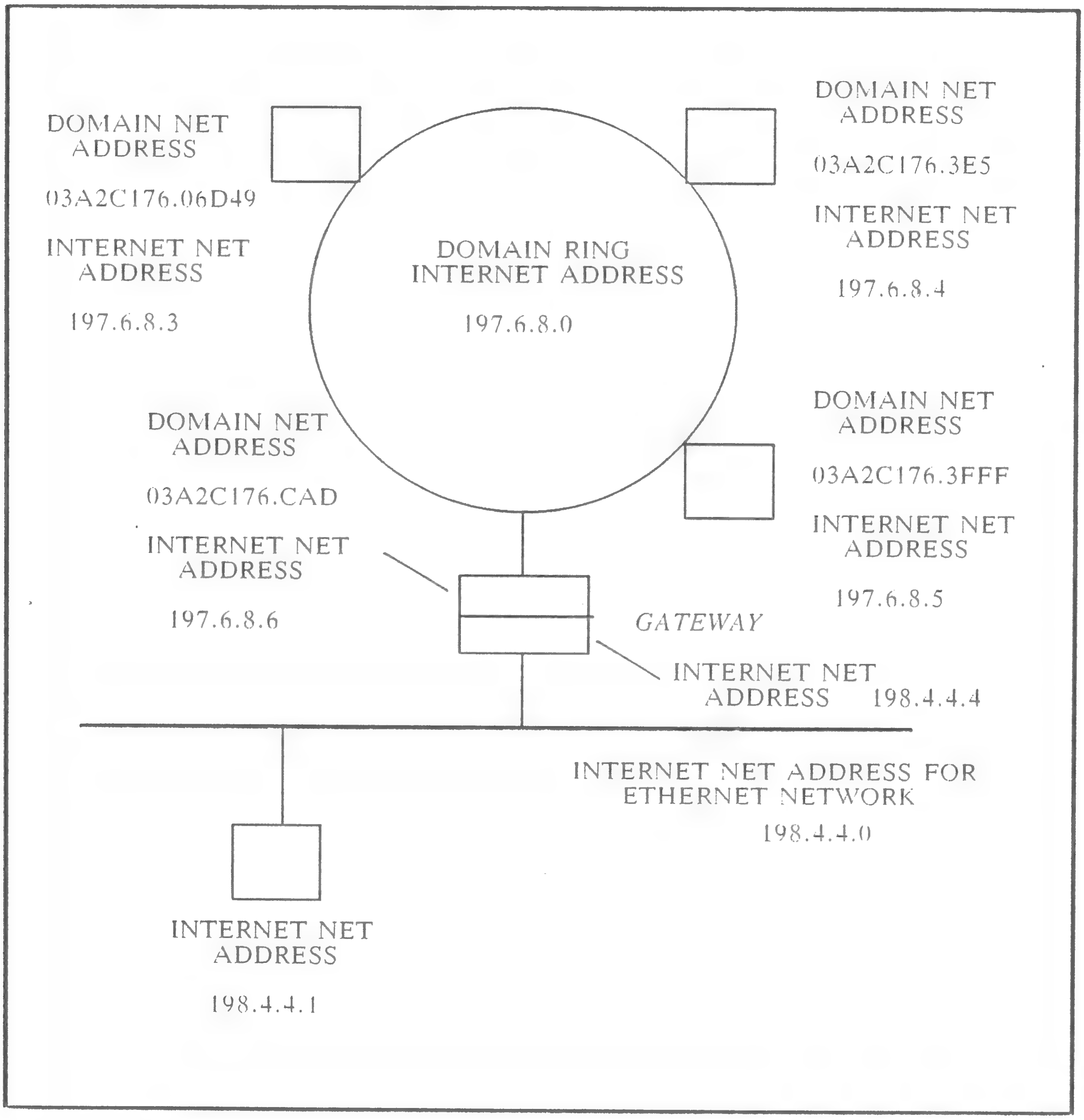
NAMES

TCP/IP REQUIRES THAT AN ASCII NAME BE ASSOCIATED WITH EACH HOST, GATEWAY AND EACH NETWORK.

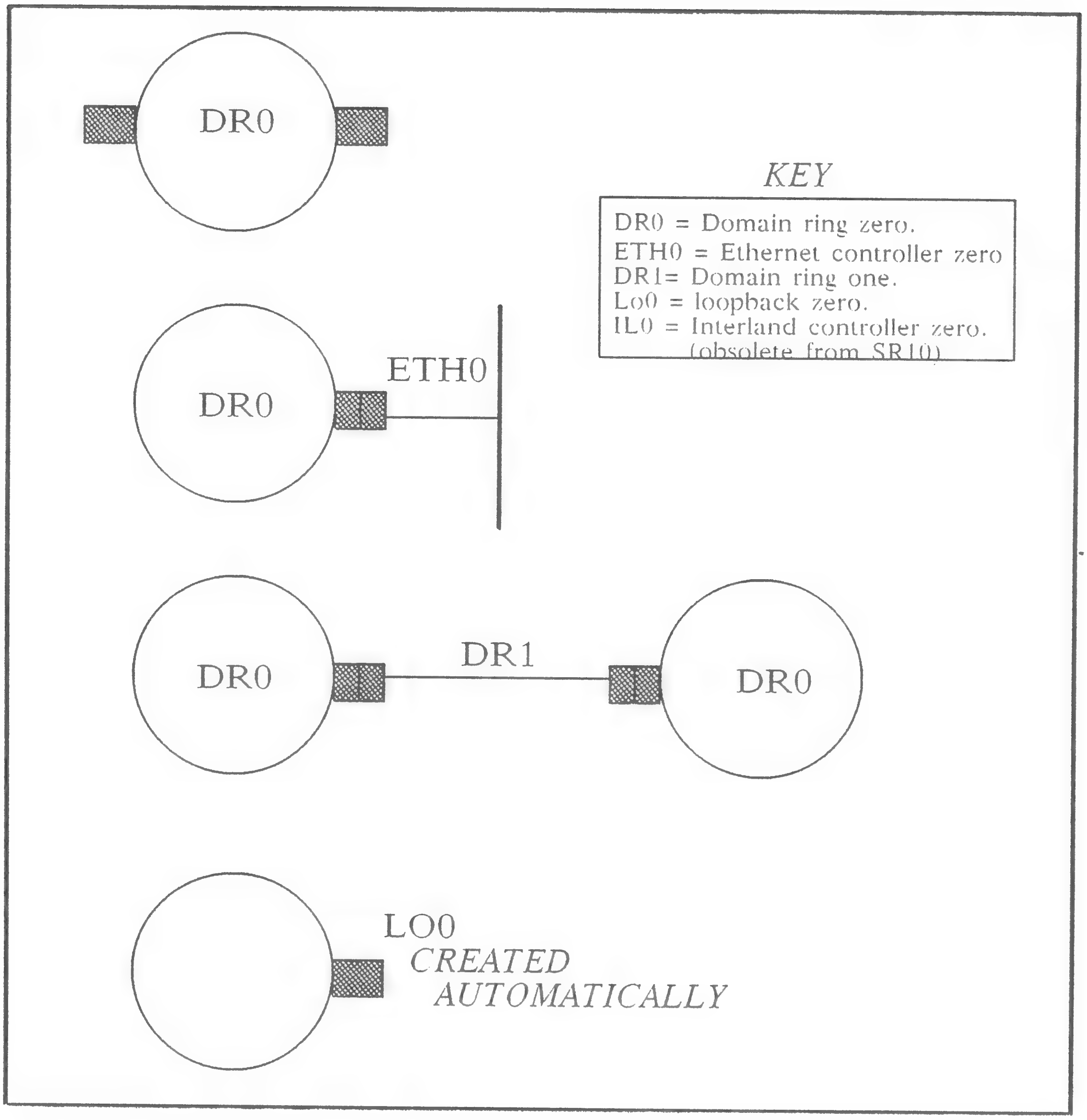


NETWORK ADDRESS

TCP/IP REQUIRES THAT A NETWORK ADDRESS BE ASSOCIATED WITH EACH
HOST, GATEWAY AND EACH NETWORK.



PHYSICAL INTERFACE



AEGIS SERVERS

TCP/IP SERVER

ENABLES TCP/IP COMMUNICATIONS ON A NODE. (one per host)

RIP_SERVER

MANAGES THE GATEWAY ROUTING TABLES. (one per gateway)

FTP_SERVER

ENABLES DIRECT FTP ACCESS TO THE HO ST. (hosts using ftp)

TELNET_SERVER

ENABLES INBOUND TELNET ACCESS TO THE HOST. (hosts accepting inbound telnet)

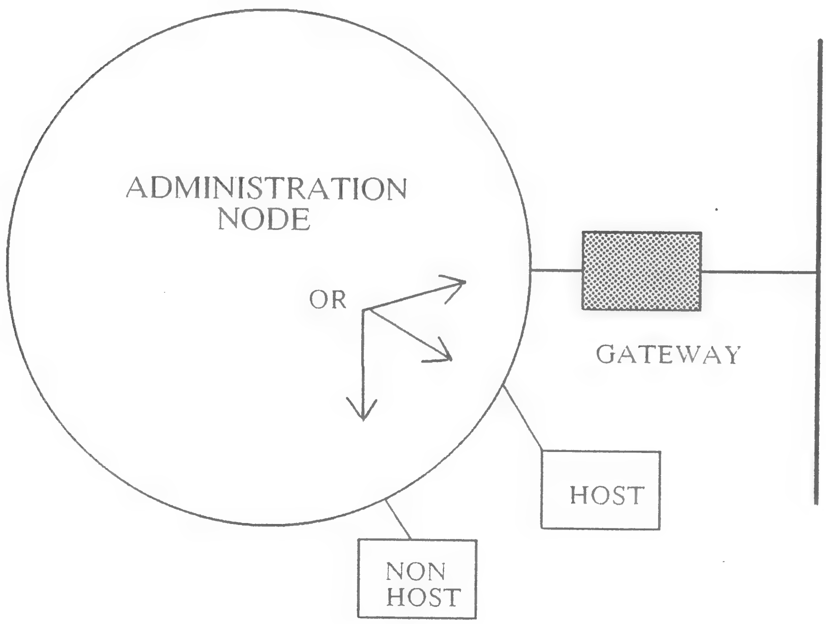
ADMINISTRATIVE NODES
NOT PART OF TCP/IP PROTOCOL

CONTAINS THE TCP/IP NAME AND ADDRESS MAPPING FILE.

/SYS/TCP/HOSTMAP/HOSTS.TXT
/SYS/TCP/HOSTMAP/LOCAL.TXT

ADMINISTRATION NODES ARE DETERMINED AT SOFTWARE LOAD TIME.

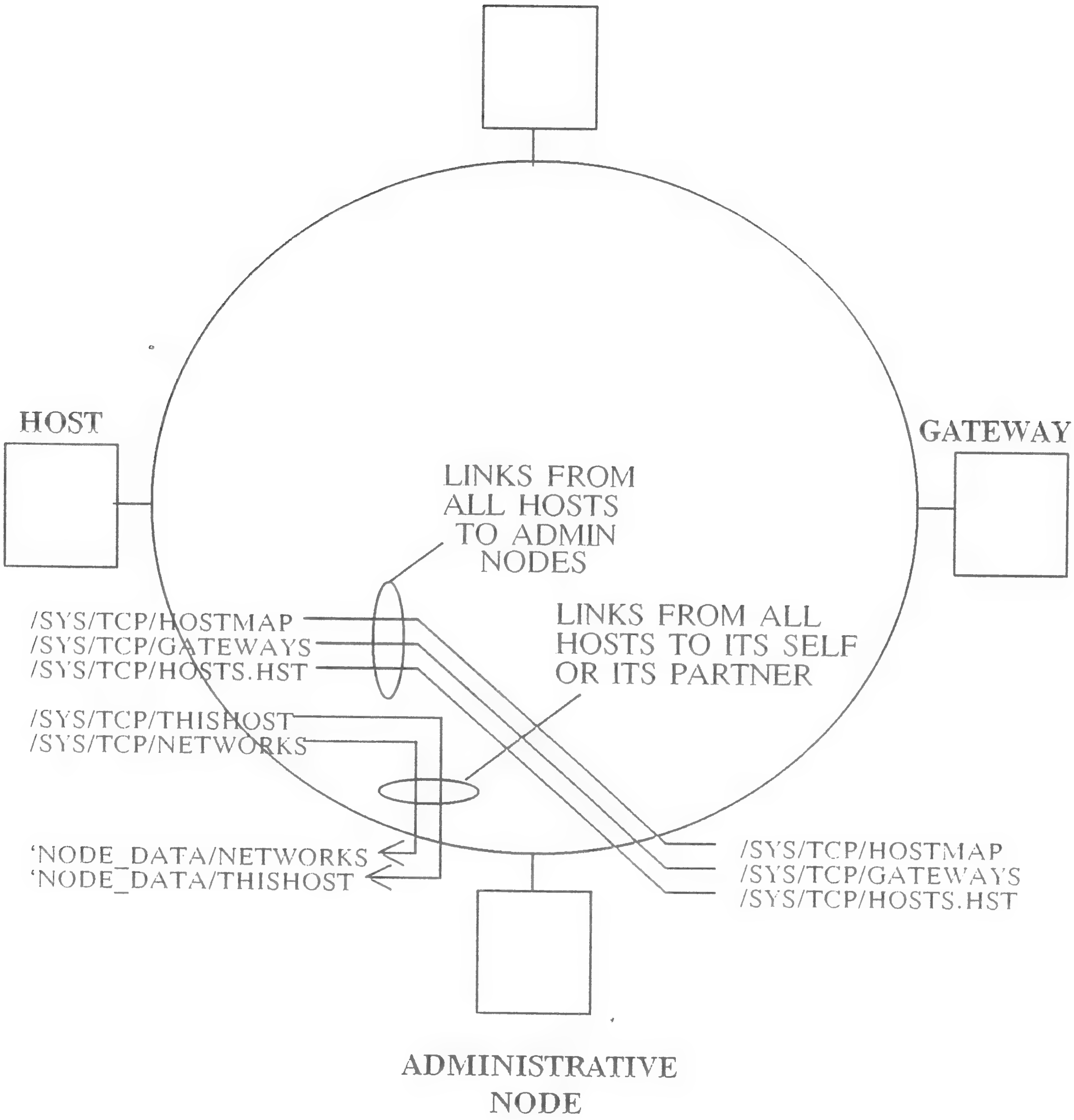
ADMINISTRATION NODE CAN BE GATEWAY



TCP/IP INFORMATION FILES
AEGIS

FILE	FUNCTION
ON ALL HOSTS:	
/sys/node_data[.nodeid]/thishost	internet name
/sys/node_data[.nodeid]/networks	internet addr & phyical interface
ON ADMINISTRATION NODES	
/sys/tcp/hostmap/local.txt	addr & names
/sys/tcp/hostmap/hosts.txt	NIC internet list
ADMINISTRATION OR GATEWAY NODES	
/sys/tcp/host_addr	non ARP hosts

LINKS IN AEGIS ENVIRONMENT



FILES REQUIRED ON ALL HOSTS

AEGIS ENVIRONMENT:

/SYS/NODE_DATA[.ID]/THISHOST

```
DARLA
```

/SYS/NODE_DATA[.ID]/NETWORKS

```
194.1.1.1 on dr0
193.1.1.2 on il0
```

TCP/IP ADMINISTRATION NODE CONFIGURATION FILES

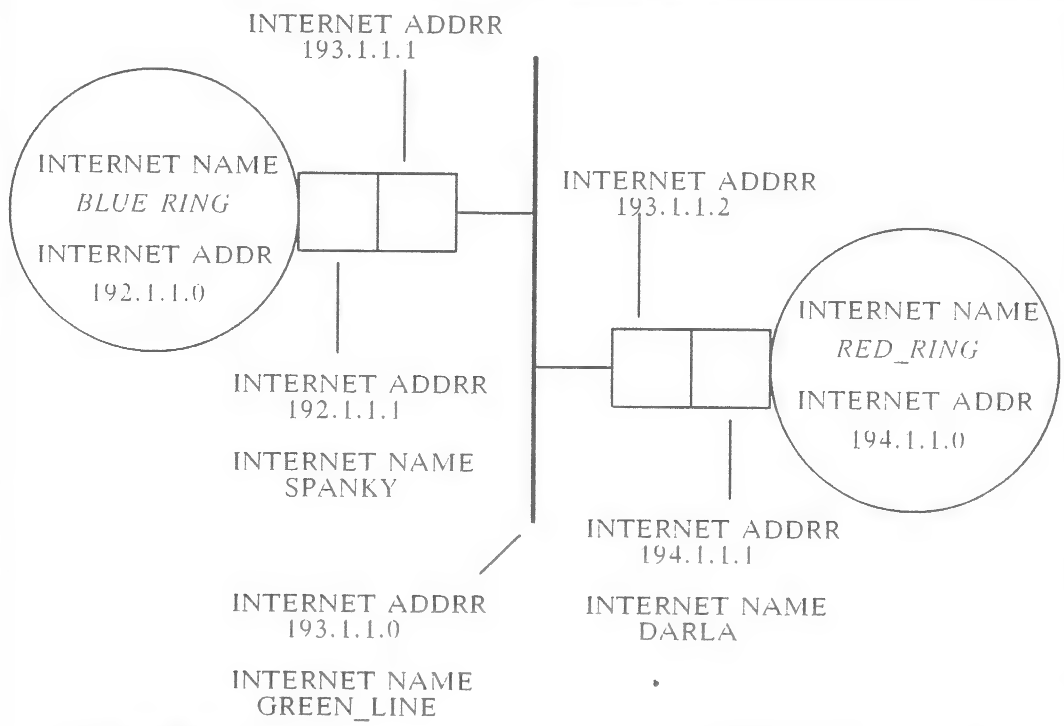
/SYS/TCP/HOSTMAP/LOCAL.TXT

```
NET : 192.1.1.0 : BLUE_RING:
NET : 193.1.1.0 : GREEN_RING:
NET : 194.1.1.0 : RED_RING:
GATEWAY : 192.1.1.1, 193.1.1.1 : SPANKY:
GATEWAY : 194.1.1.1, 193.1.1.2 : DARLA:
HOST : 192.1.1.1 : SPANKY:
HOST : 194.1.1.1 : DARLA:
```

CREATE THE HOST TABLES

$/SYS/TCP/HOSTMAP/MAKEHOST.SH

THE BIG PICTURE



NETWORKS
```
192.1.1.1 0n dr0
193.1.1.1 on il0
```

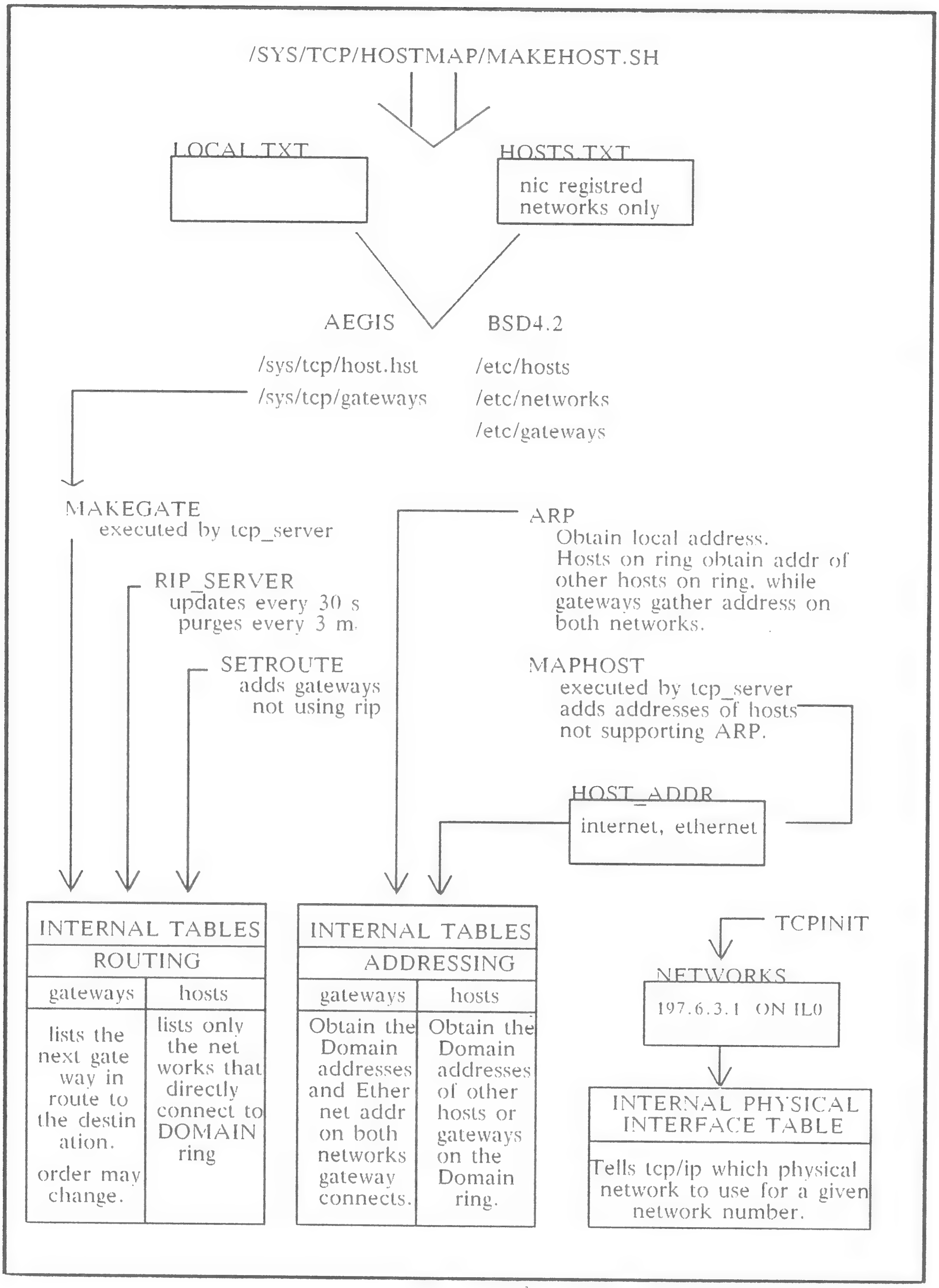
THISHOST
```
spanky
```

NETWORKS
```
194.1.1.1 on dr0
193.1.1.2 on il0
```

THISHOST
```
darla
```

/SYS/TCP/HOSTMAP/LOCAL.TXT
```
net : 192.1.1.0 : blue_ring :
net : 193.1.1.0 : green_line :
net : 194.1.1.0 : red_ring :
gateway : 192.1.1.1, 193.1.1.1 : spanky :
gateway : 194.1.1.1, 193.1.1.2 :darla :
host : 192.1.1.1 : spanky :
host : 194.1.1.1 : darla :
```

INTERNAL MAPPING



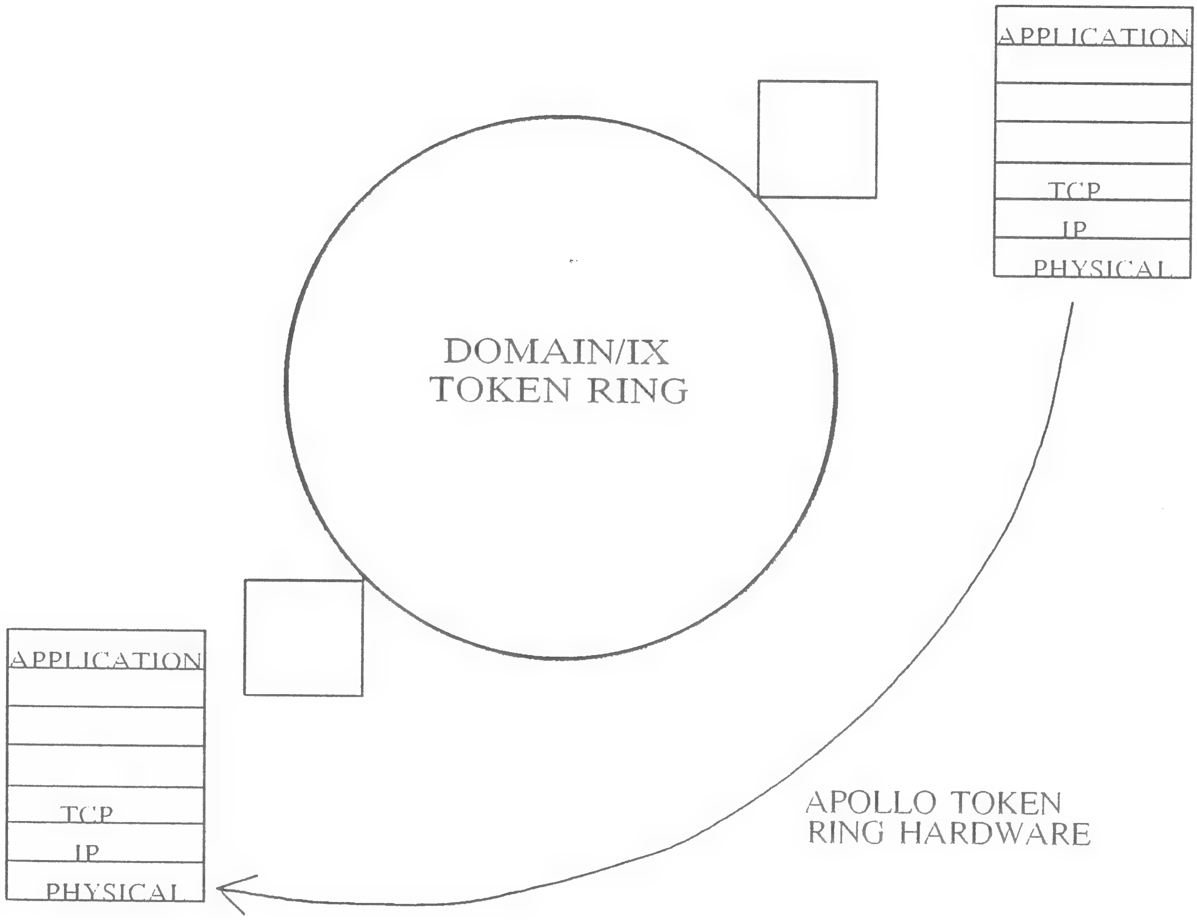
/SYS/TCP/HOSTMAP/MAKEHOST.SH
LOCAL.TXT
HOSTS.TXT
nic registred networks only
AEGIS
BSD4.2
/sys/tcp/host.hst
/sys/tcp/gateways
/etc/hosts
/etc/networks
/etc/gateways
MAKEGATE
executed by tcp_server
RIP_SERVER
updates every 30 s
purges every 3 m.
SETROUTE
adds gateways not using rip
ARP
Obtain local address.
Hosts on ring obtain addr of other hosts on ring. while gateways gather address on both networks.
MAPHOST
executed by tcp_server
adds addresses of hosts not supporting ARP.
HOST_ADDR
internet, ethernet
INTERNAL TABLES
ROUTING
gateways
hosts
lists the next gate way in route to the destin ation.
order may change.
lists only the net works that directly connect to DOMAIN ring
INTERNAL TABLES
ADDRESSING
gateways
hosts
Obtain the Domain addresses and Ether net addr on both networks gateway connects.
Obtain the Domain addresses of other hosts or gateways on the Domain ring.
TCPINIT
NETWORKS
197.6.3.1 ON IL0
INTERNAL PHYSICAL INTERFACE TABLE
Tells tcp/ip which physical network to use for a given network number.

SECTION IV

BSD4.2 TCP/IP CONFIGURATION

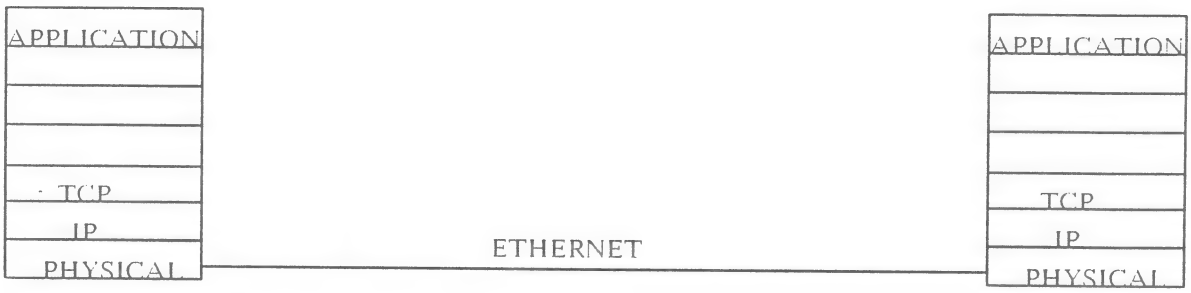
DOMAIN/BSD4.2 TCP/IP

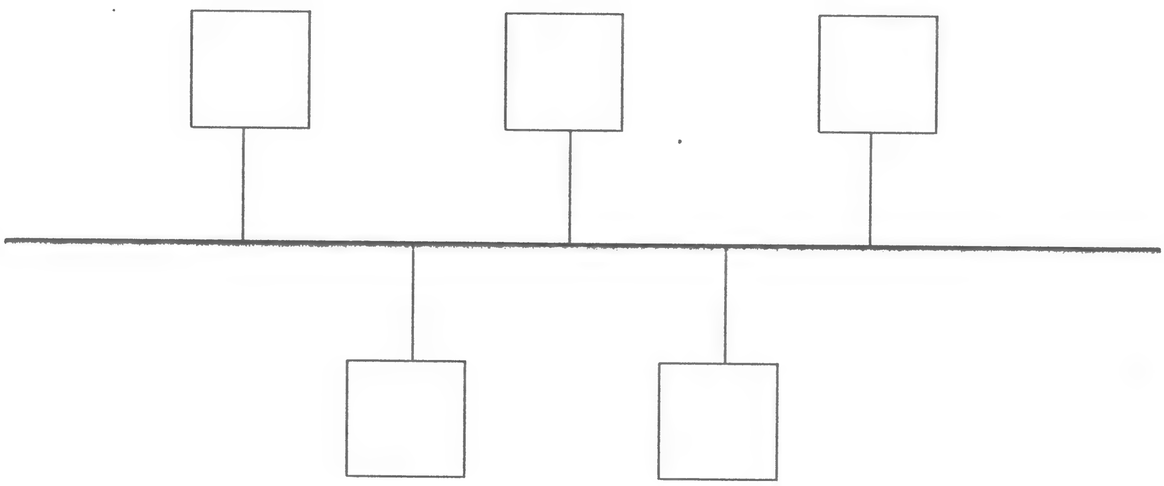
ALLOWS APPLICATIONS RUNNING UNDER DOMAIN/IX
ENVIRONMENT TO COMMUNICATE OVER RING HARDWARE



BSD4.2 TCP/IP

ALLOWS APPLICATIONS RUNNING IN A UNIX ENVIRONMENT TO COMMUNICATE WITH ONE ANOTHER OVER **ETHERNET**





BSD4.2 SERVERS

routed

Manages the gateway network routing tables

rwhod

System status server, maintains database used by **rwho** and **ruptime**.

sendmail

Handles mail received over the internet.

tftpd

Enables TFTPD access to the host.

inetd

Starts daemons listed below as needed.

ftpd

Enables direct FTP access to the host.

telnetd

Enables inbound Telnet access to the host.

rexecd

Enables remote execution of commands.

rlogind

Enables remote login to this node.

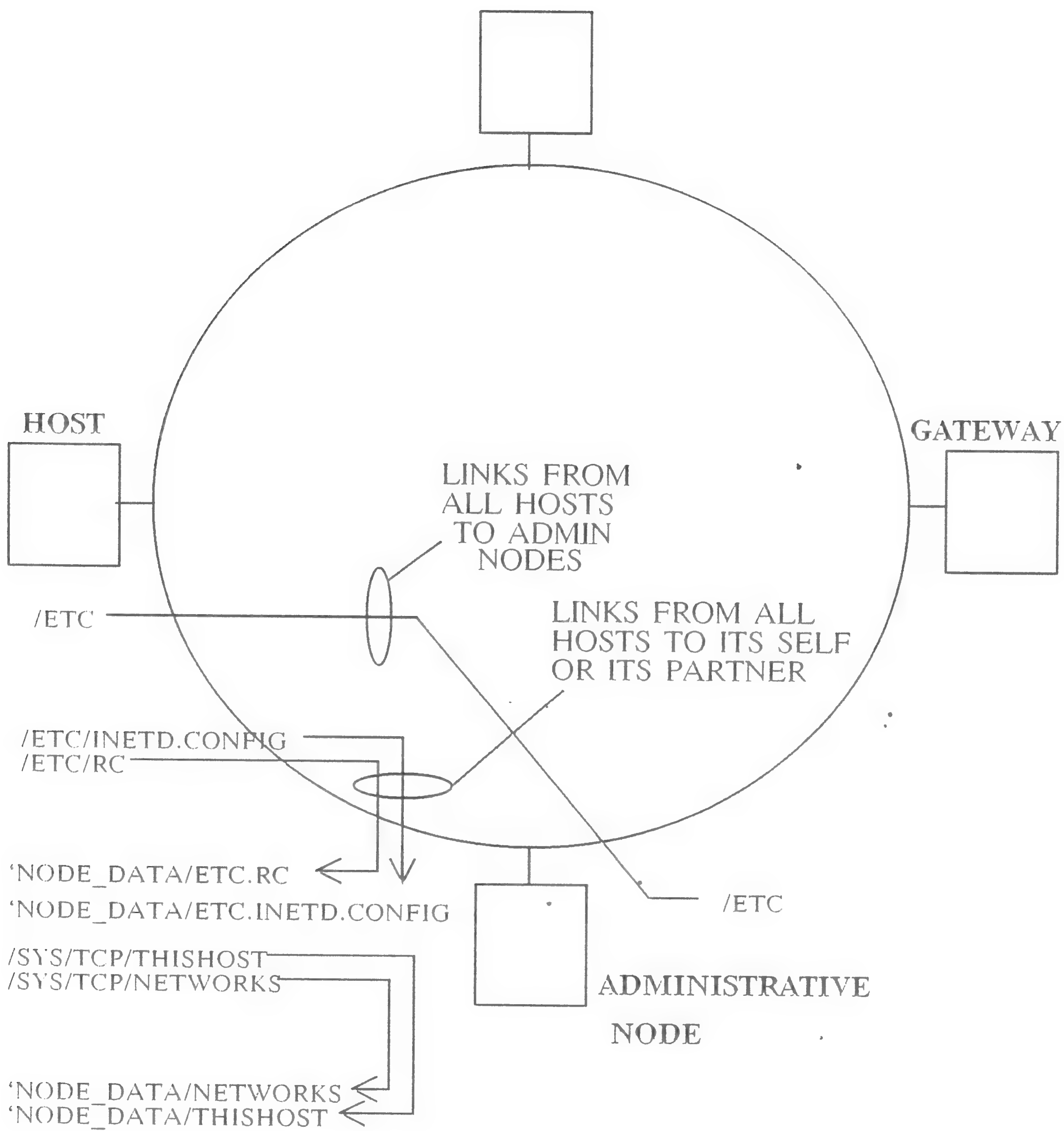
rshd

Enables remote execution of commands on this node with user authentication

TCP/IP INFORMATION FILES
BSD4.2

FILE	FUNCTION
ON ALL BSD4.2 ADMINISTRATIVE NODES:	
/etc/hosts.equiv	Contains the names of all hosts that can access you using **rlogin**, **rsh** and **rcp** without password authentication.
/etc/gateways	Contains routing information for remote destinations that do not use the **routed** daemon.
/etc/hosts	Contains the names and internet addresses of all hosts on the DOMAIN network or the internet
/etc/networks	Contains the internet network numbers and names of all accessible networks

LINKS FOR TCP/IP DOMAIN/IX ENVIRONMENT



FILES REQUIRED ON ALL HOSTS

BSD4.2 ENVIRONMENT:

/etc/hosts.equiv

```
DARLA
                                    REF MTCP/IPCP P 3-31
```

/etc/gateways

```
193.1.1.0   darla gateway spanky 2   active
                                    REF MTCP/IPCP P 3-32
```

TCP/IP on DOMAIN ring or DOMAIN internet only

/etc/networks

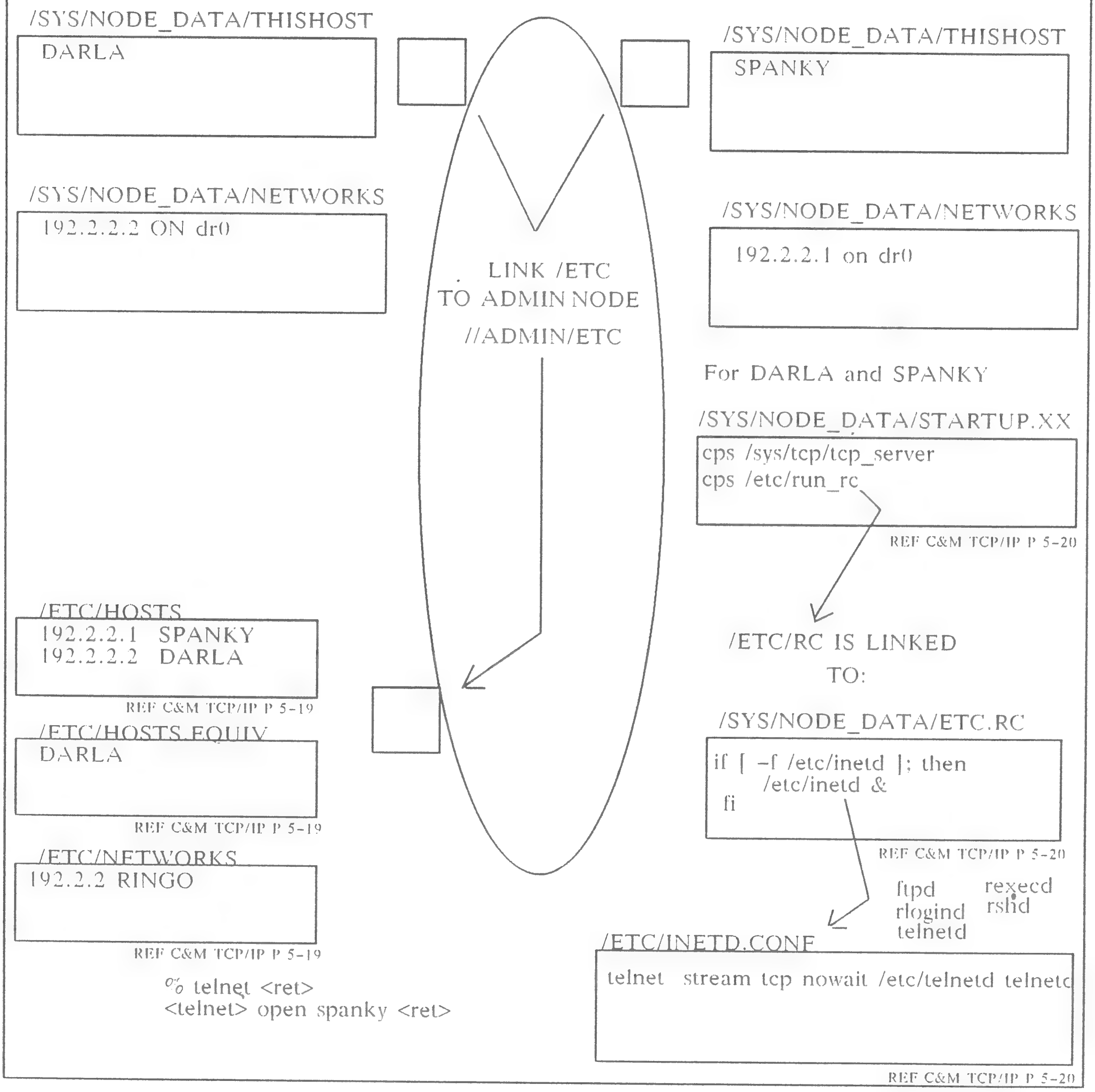
```
domain-ring      197.9.8
```

/etc/hosts

```
127.0.0.1        poindexter
```

BSD4.2 TCP/IP FILES

PROCEDURE 5-4



CHECKLIST FOR DOMAIN/IX BSD4.2 TCP/IP

1. Load DOMAIN/AEGIS software.

2. Load DOMAIN/IX software.

3. Load BSD4.2 TCP/IP software.

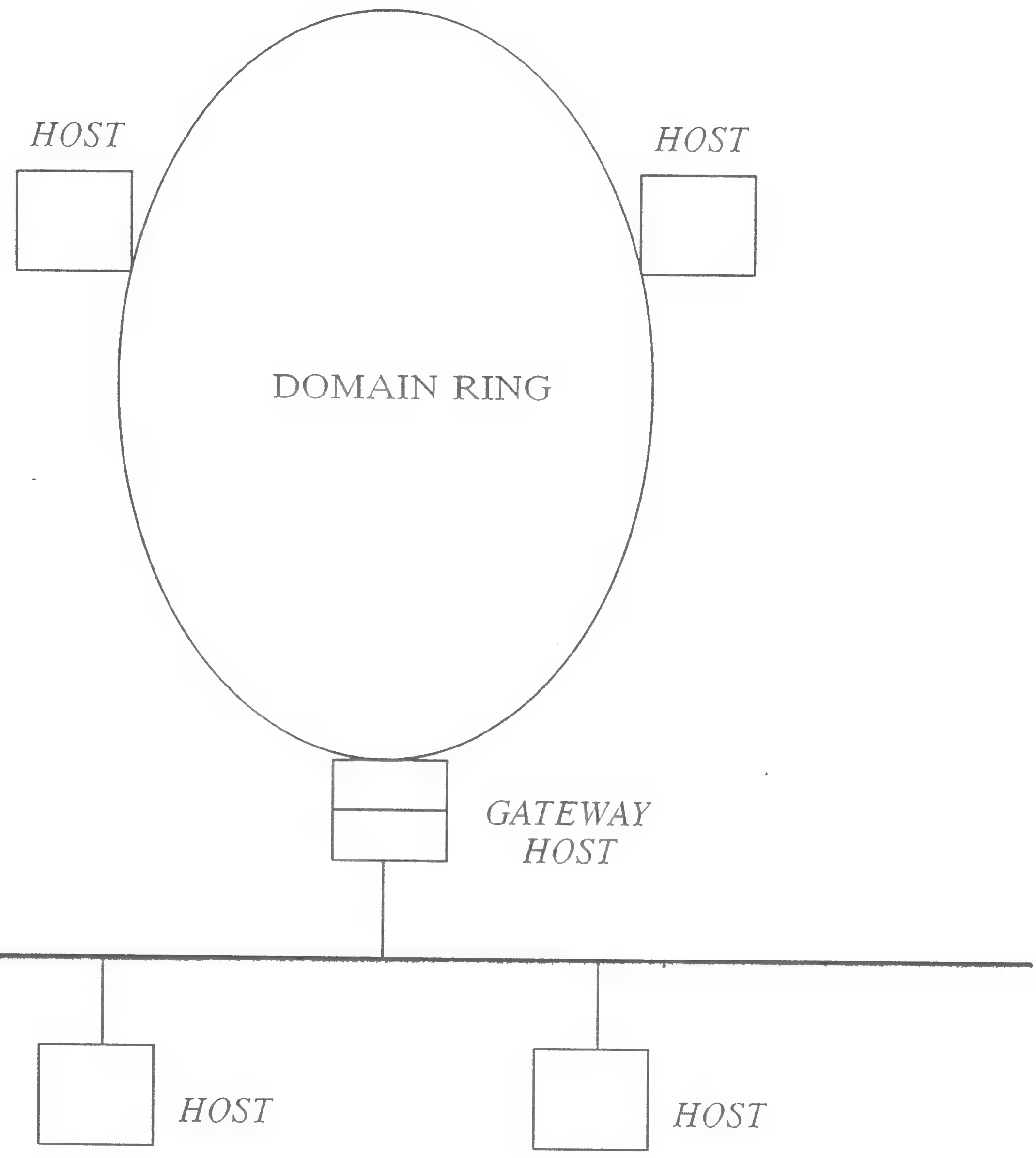
4. Use procedure 5-4 to configure the following files:

    a. /SYS/NODE_DATA/THISHOST
    b. /SYS/NODE_DATA/NETWORKS
    c. /SYS/NODE_DATA/STARTUP.XX
    d. /SYS/NODE_DATA/ETC.RC
    e. /ETC/INETD.CONF
    f. /ETC/HOSTS
    g. /ETC/HOSTS.EQUIV
    h. /ETC/NETWORKS

5. Power up node and verify that tcp_server and inetd are running using the following command: % **ps -aux**

6. FTP or TELNET to self or another host.

DOMAIN/IX GATEWAY TCP/IP



DOMAIN/IX GATEWAY TCP/IP

PROCEDURE 5-1 & 5-3

/SYS/NODE_DATA/THISHOST

DARLA

/SYS/NODE_DATA/NETWORKS

192.2.2.2 ON dr0

LINK ALL HOSTS:

/SYS/TCP/HOSTMAP
TO ADMIN NODE:

//ADMIN/SYS/TCP/&
HOSTMAP.

/SYS/NODE_DATA/THISHOST

SPANKY

/SYS/NODE_DATA/NETWORKS

192.2.2.1 on dr0

For DARLA and SPANKY

/SYS/NODE_DATA/STARTUP.XX

cps /sys/tcp/tcp_server
cps /etc/run_rc

REF C&M TCP/IP P 5-14

/ETC/RC IS LINKED
TO:

/SYS/NODE_DATA/ETC.RC

```
if [ -f /etc/inetd ]; then
       /etc/inetd &
 fi
```

REF C&M TCP/IP P 5-14

ftpd rexecd
rlogind rshd
telnetd

/SYS/TCP/HOSTMAP/LOCAL.TXT

NETWORKS:
GATEWAYS:
HOSTS:

REF C&M TCP/IP P 3-10

$ MAKEHOST.SH

	aegis	domain/ix tcp/ip
local.txt +hosts.txt =	hosts.hst gateways	/etc/hosts /etc/networks /etc/gateways

REF C&M TCP/IP P 3-5

% telnet <ret>
>connect spanky <ret>

/ETC/INETD.CONF

telnet stream tcp nowait /etc/telnetd telnetd

REF C&M TCP/IP P 5-14

CHECKLIST FOR **DOMAIN/IX TCP/IP** GATEWAY

1. Load DOMAIN/AEGIS software.

2. Load DOMAIN/IX software.

3. Load TCP/IP software.

4. Use procedure 5-1 & 5-3 to configure the following configuration files.

   a. /SYS/TCP/THISHOST
   b. /SYS/TCP/NETWORKS
   c. /SYS/NODE_DATA/STARTUP.XX
   d. /SYS/NODE_DATA/ETC.RC
   e. /ETC/INETD.CONF
   f. /ETC/HOSTS.EQUIV

5 Run makehost.sh

6. Power up node and verify that tcp_server and inetd are running by using the following command: **% ps -aux**

7. FTP or TELNET to self or another host.

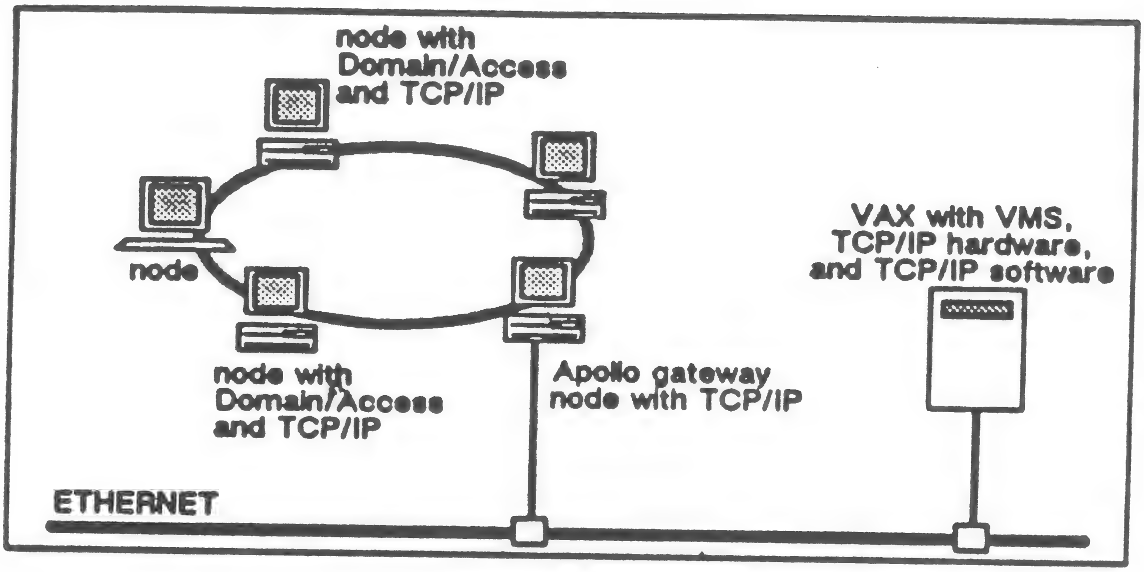


Figure 1-2. A Sample Network Configuration for the Domain/Access Application

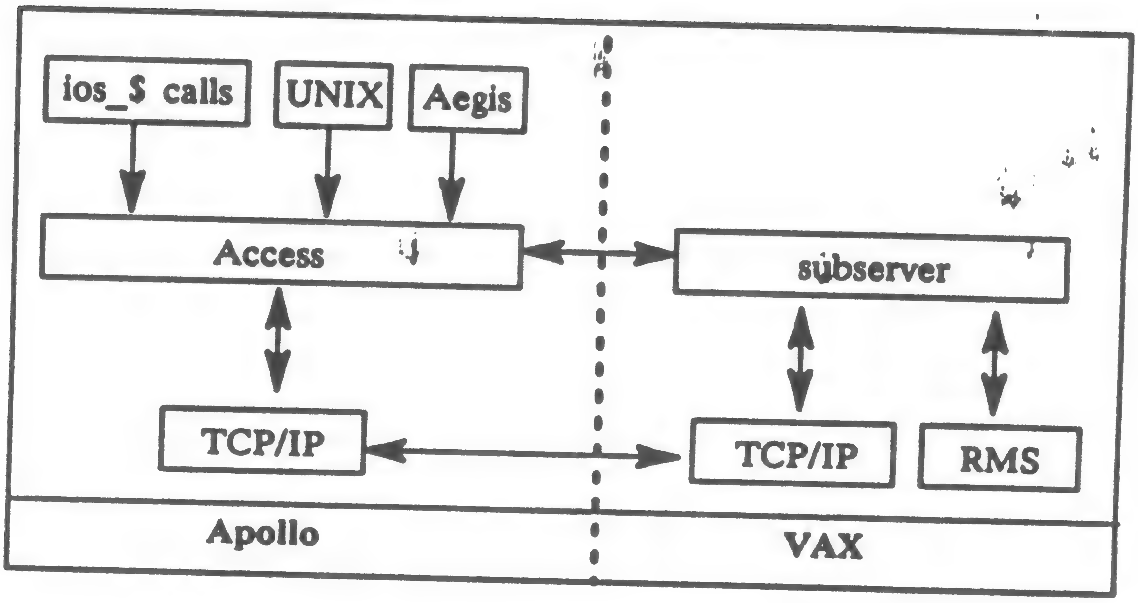


Figure 1-1. Relationship of Apollo Workstation and VAX Node

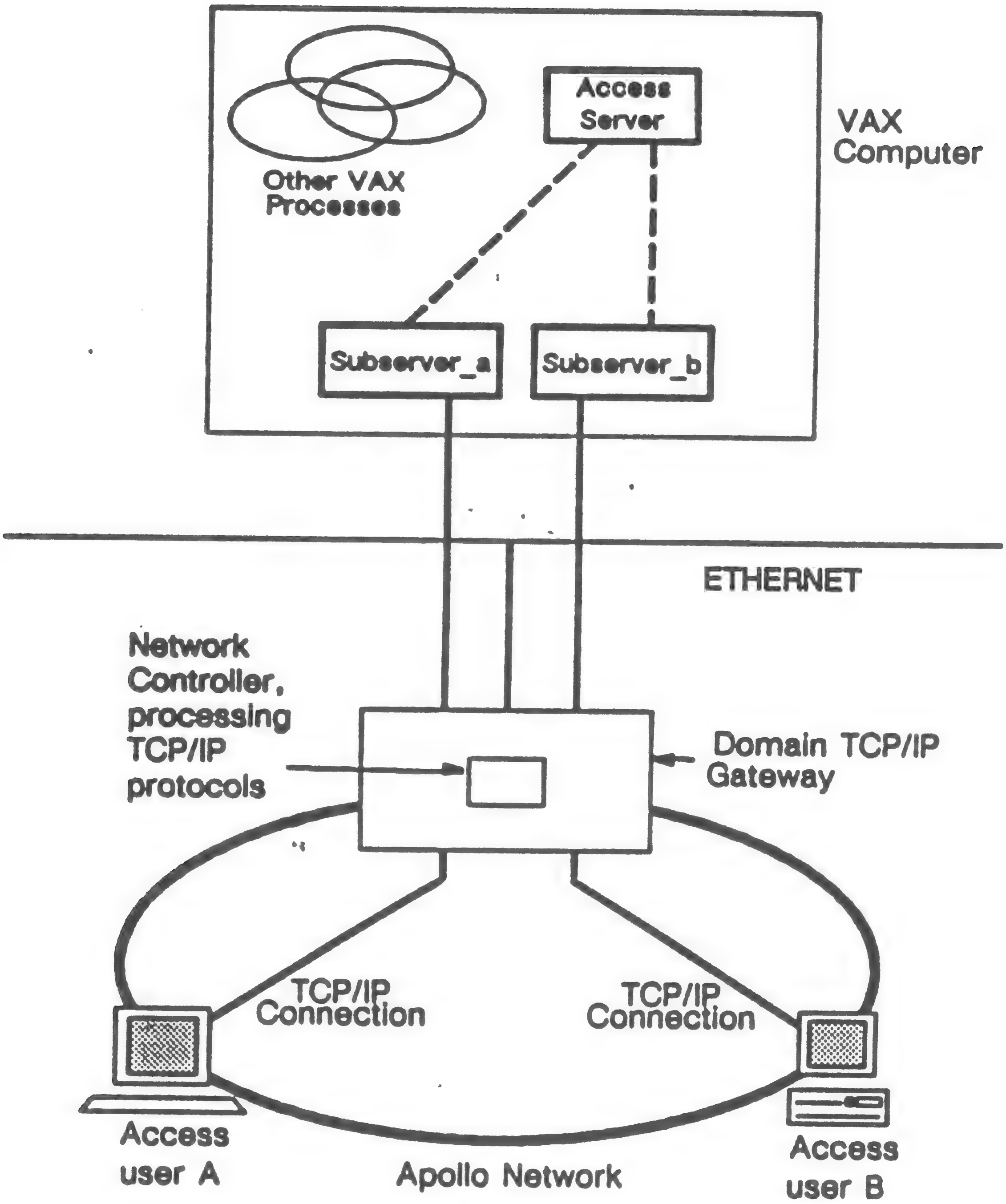


Figure 1–3. Creating Domain/Access Subservers

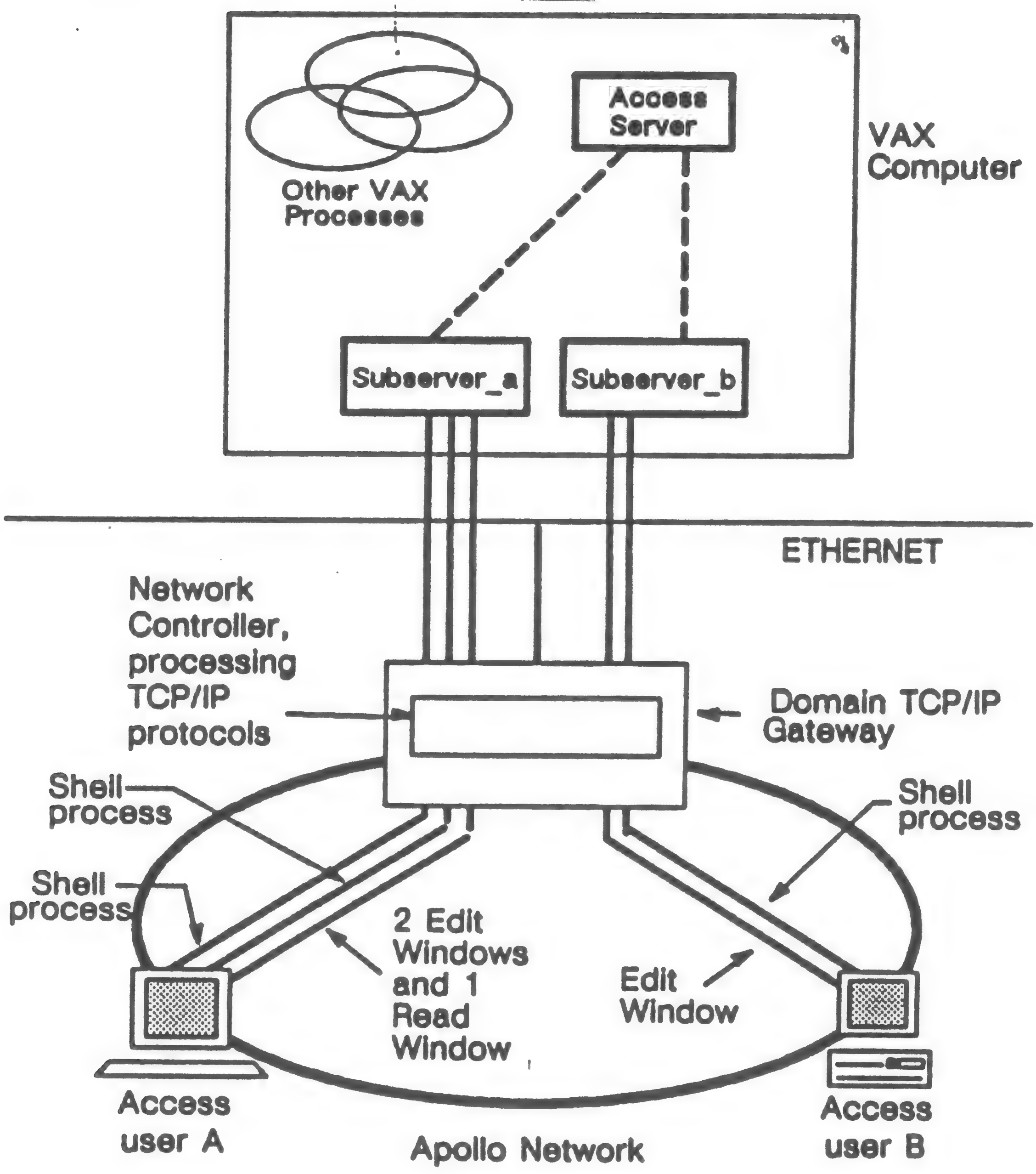
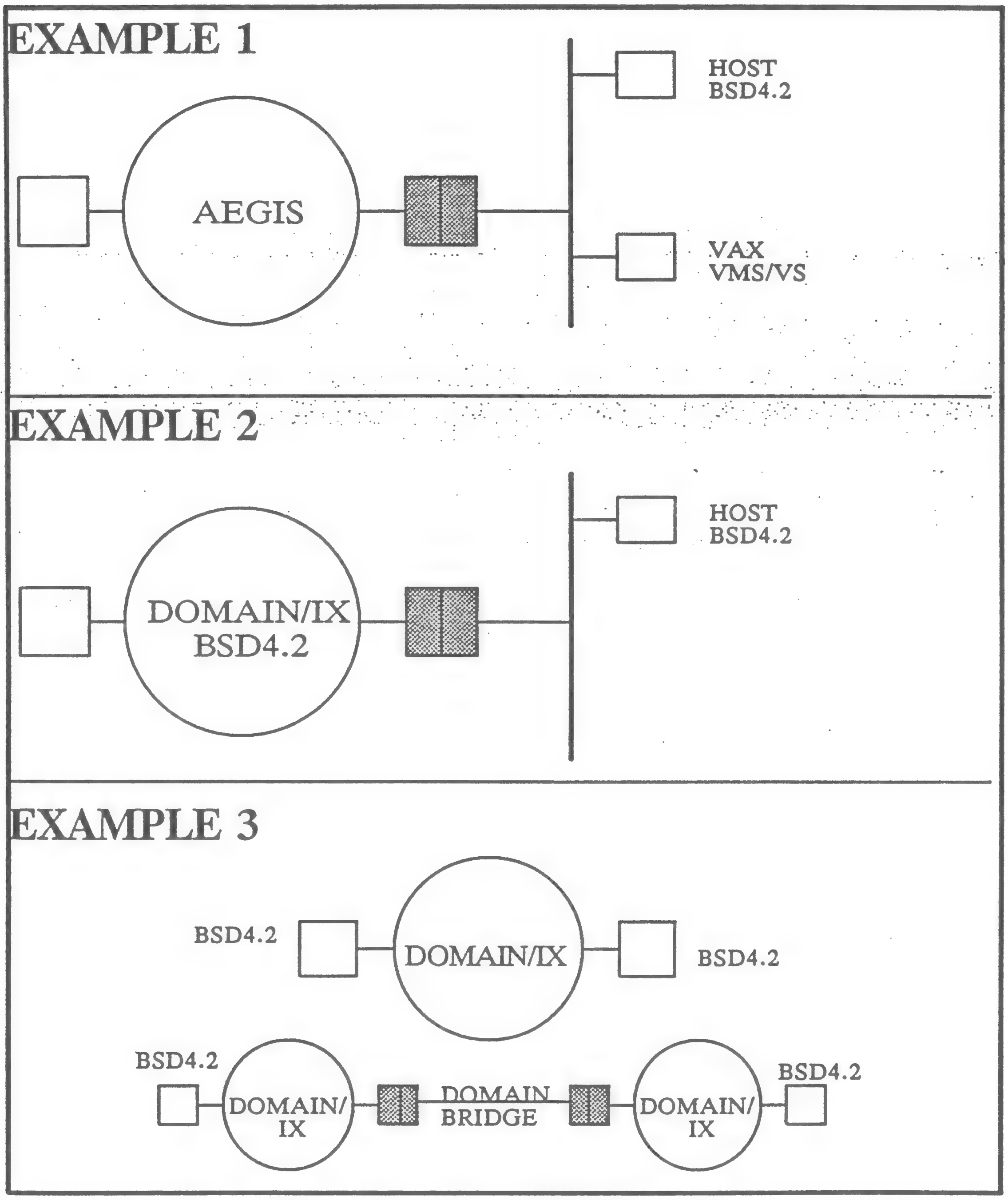


Figure 1–4. Creating Multiple TCP/IP Connections with Domain/Access Subservers

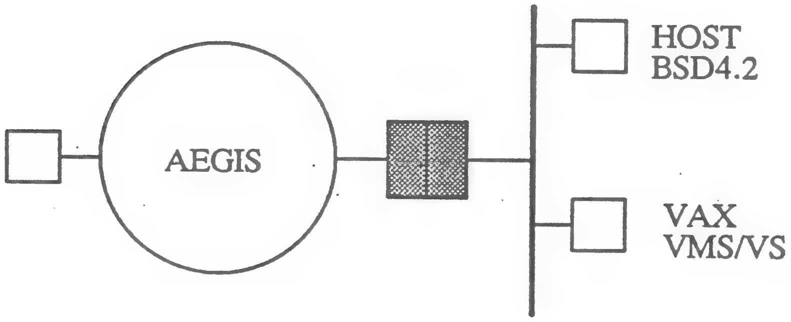
SECTION V

LAB EXERCISE

THREE CONFIGURATIONS FOR TCP/IP



IF YOU'RE USING EXAMPLE 1;



THEN PERFORM THE FOLLOWING PROCEDURES IN THE MANUAL CALLED *Managing TCP/IP–Based Communications Products* AND IN THIS ORDER.

1 Procedure 4–1

Configuring the Administative Node

2. Procedure 4–2

Configuring Each Host and Gateway

3. Procedure 4–5

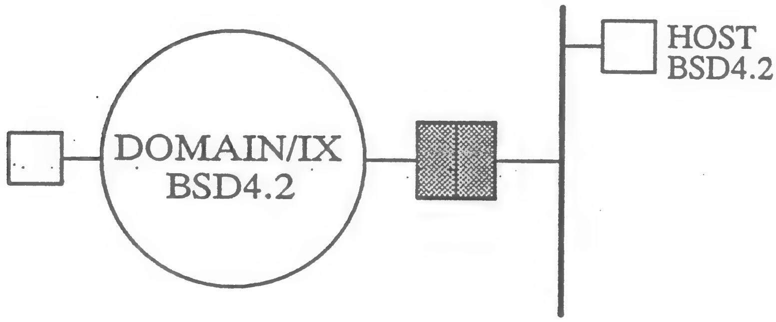
Configuring Non–DOMAIN Remote Hosts

4. Procedure 4–6

If You're Using the DOMAIN/ACCESS Product Then Use This Procedure to Configure Each VAX/VMS System.

REF MTCP/IPCP P 4–2

IF YOU'RE USING EXAMPLE 2;



THEN PERFORM THE FOLLOWING PROCEDURES IN THE MANUAL CALLED *Managing TCP/IP–Based Communications Products* AND IN THIS ORDER:

1 Procedure 4–1

Configuring the Administative Node

2. Procedure 4–3

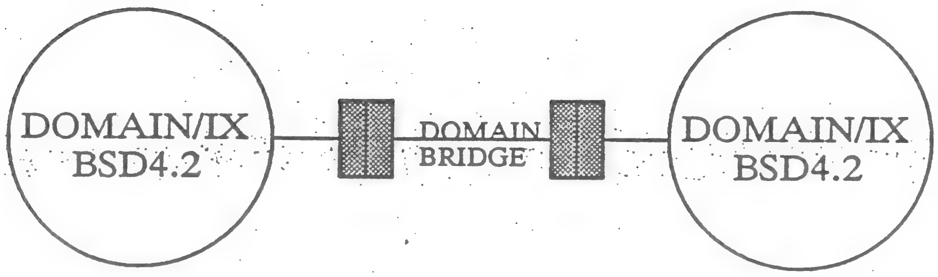
Configuring Each Host and Gateway

3. Procedure 4–5

Configuring Non–DOMAIN Remote Hosts

REF MTCP/IPCP P 4–2

IF YOU'RE USING EXAMPLE 3;



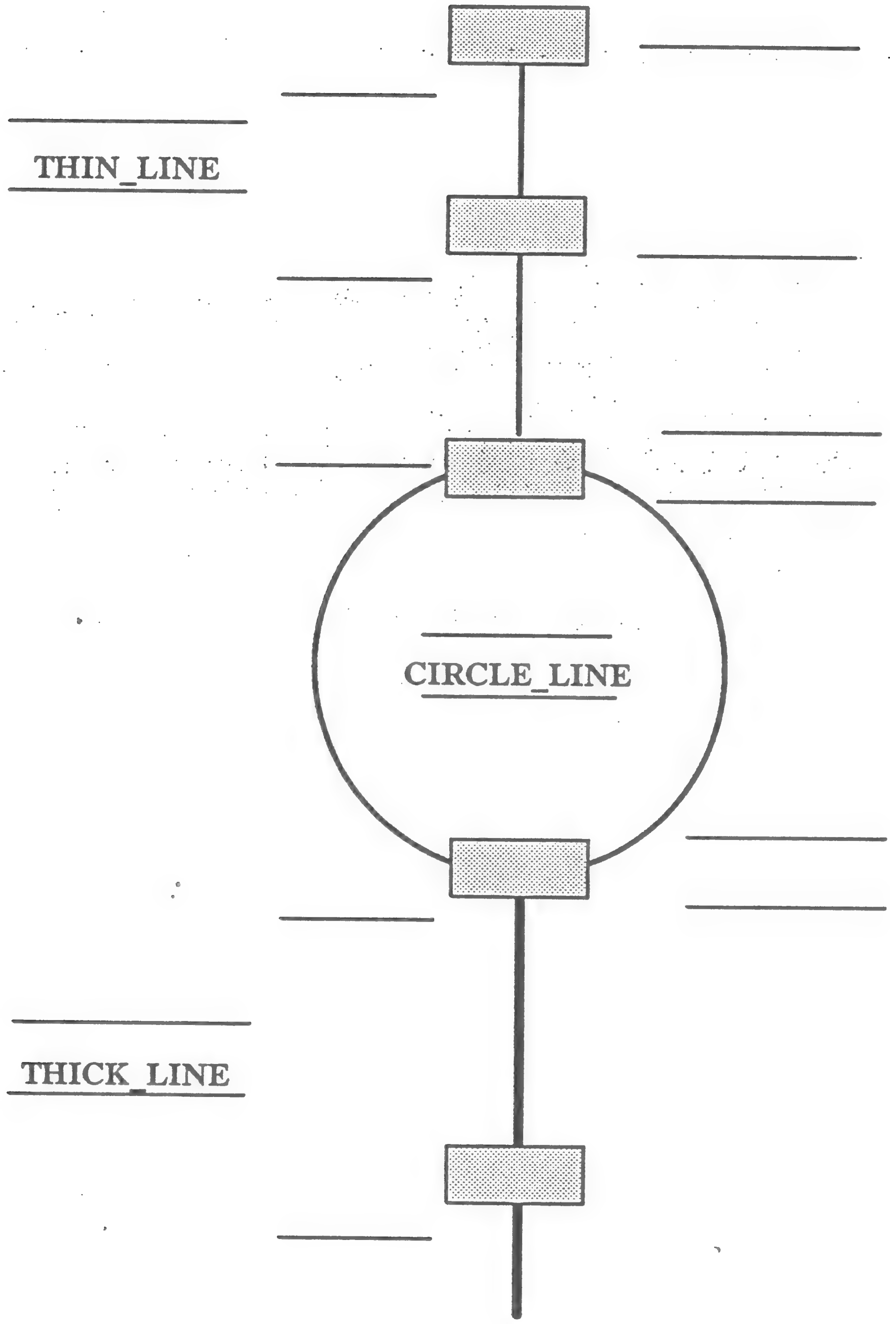
THEN PERFORM THE FOLLOWING PROCEDURE IN THE MANUAL CALLED *Managing TCP/IP–Based Communications Products.*

1 Procedure 4–4

REF MTCP/IPCP P

4–2

THE BIG PICTURE



/SYS/TCP/HOSTMAP/LOCAL.TXT

NET :
NET :
NET :
GATEWAY :
GATEWAY :
HOST :
HOST :
HOST :
HOST :
HOST :

/SYS/NODE_DATA/NETWORKS /SYS/NODE_DATA/THISHOST

GATEWAY NODE ________

________ on dr0

________ on eth0

GATEWAY NODE ________

________ on dr0

________ on eth0

HOST NODE ________

________ on eth0

HOST NODE ________

________ on eth0

HOST NODE ________

________ on eth0

MODULE 6

NFS

AGENDA

a, INTRODUCTION TO NFS

b, CONFIGURATION ,OPERATION AND SOFTWARE INSTALLATION

c, LAB

NFS

THE NETWORK FILESYSTEM

Gives the user transparent access to files in a HETEROGENEOUS ENVIRONMENT.

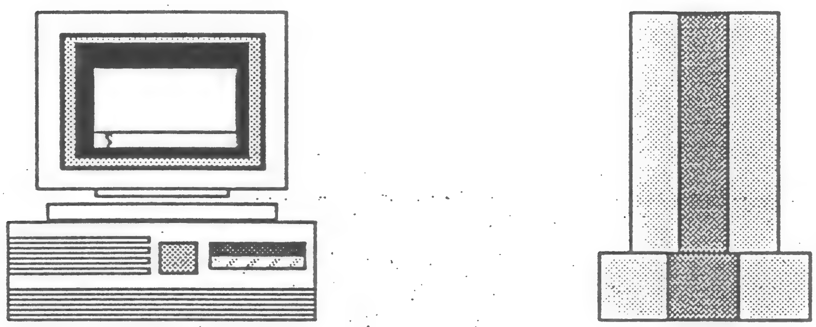
DESIGN GOALS.

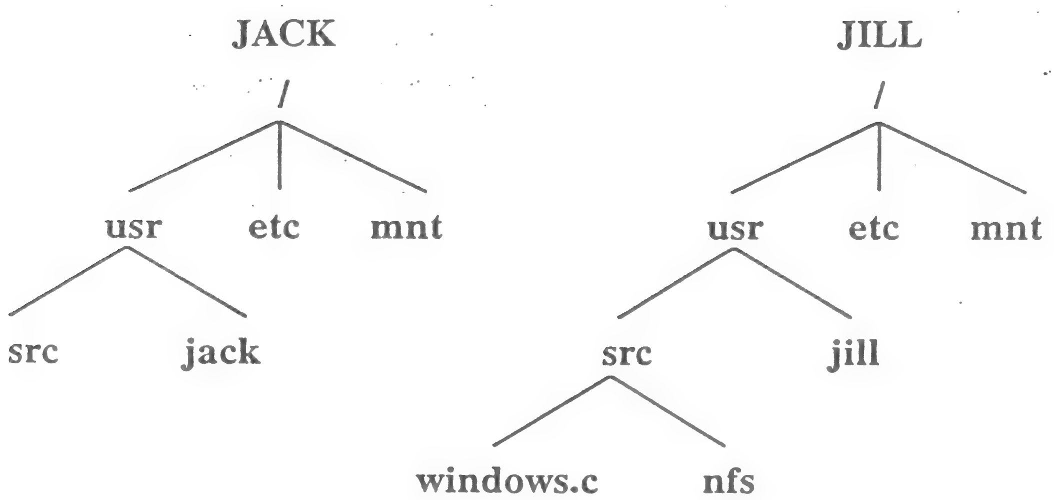
- *MACHINE AND OPERATING SYSTEM INDEPENDENT*
- *TRANSPARENT ACCESS*
- *CRASH RECOVERABILITY*

NFS

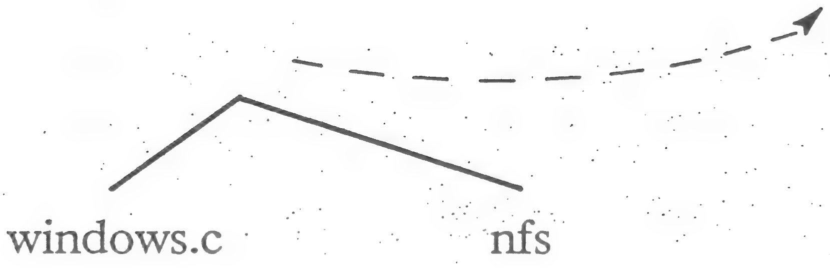
Transparent Access

- A client *mounts* a portion of a server's file space onto a *mount point* within its own file space.





NFS



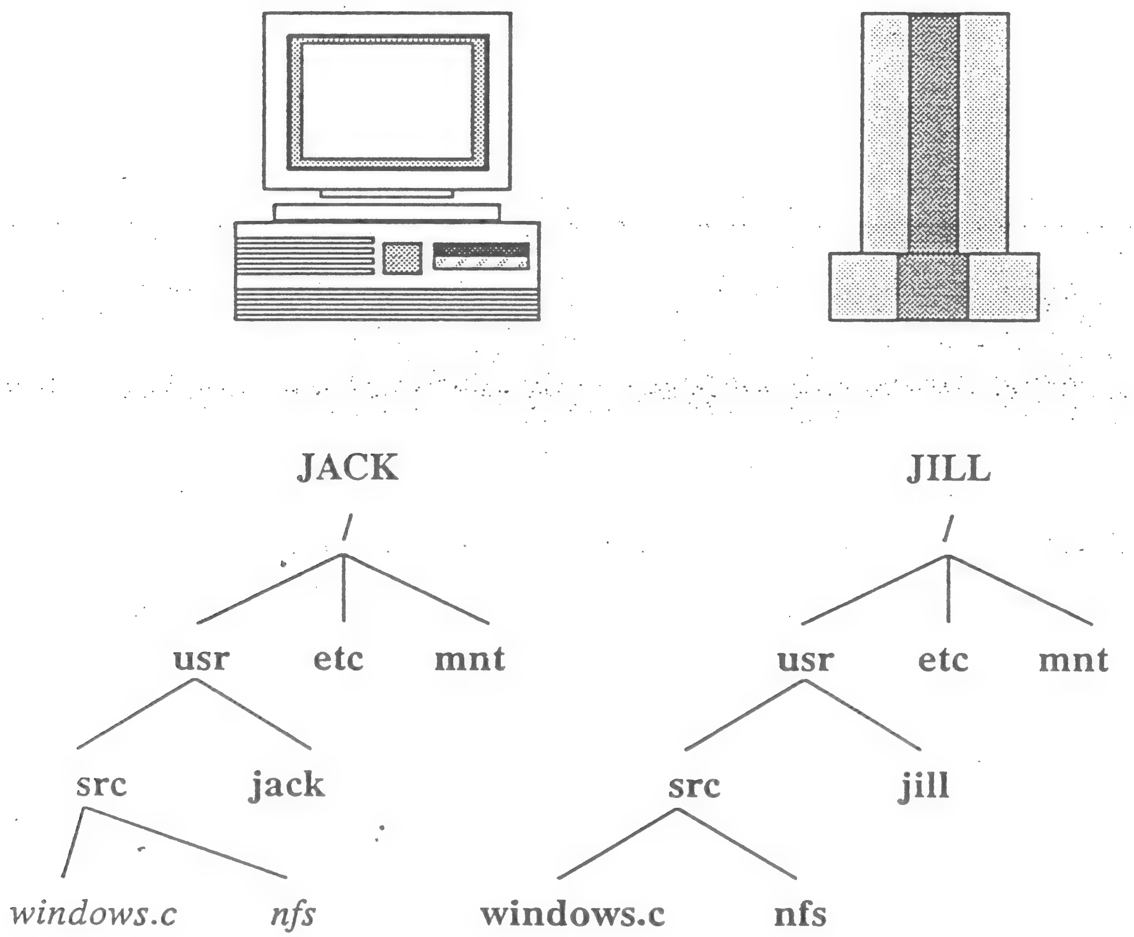
mount jill : /usr/src /usr/src

NFS

TRANSPARENT ACCESS

MOUNT POINTS CAN BE ANYWHERE

- All remote file naming semantics are handled once by the mount operation. The remote files effectively become part of the client's file name space.




```
% ls /usr/src
  nfs windows.c
```

NFS

CRASH RECOVERABILITY

- If client or network crashes, the server takes no action

- If server crashes

  * CLIENT MAY HANG

  * CLIENT MAY TIME-OUT

Resilience comes from.

  * STATELESS SERVERS

  * ANY OPERATION CAN BE ATTEMPTED MORE THAN ONCE

NFS

MAJOR COMPONENTS

Server Side

/etc

- PORTMAPPER
- MOUNTD
- NFSD

Zonder TCP geen M.fs.
SR9.7 alleen op Domainix

Client Side

- MOUNT COMMAND EXTENDED
- THE REST IS INVISIBLE TO USER

NFS

PORTMAPPER

- Server side process
- Maps RPC program numbers to port numbers
- No need to have a well known port for every program that uses RPC
- Server process registers with portmapper at startup
- Client probes the portmapper to find out the correct port to send requester to.

PROGRAM NUMBER = 1000000

VERSION = 1

NFS

MOUNTD

- Server side processes
- Gets user off the ground

    Checks.

    * USER IDENTITY
    * ACCESS PERMISSION
    * PASSES BACK THE FIRST 'FILEHANDLE'

- Maintains a list of client mount requests

PROGRAM NUMBER	=	100005
VERSION	=	1

NFS

NFSD

- Server Side Process

- Services incoming file system requests.

PROGRAM NUMBER	=	100003
VERSION	=	2

NFS

Files You Need To Know About

/ETC/EXPORTS – *List of filesystems on the node that can be remotely mounted and by who.*

– *Used by MOUNTD*

/ETC/FSTAB – *Table of remote system used by local host*

– *Can be used in conjunction with MOUNT command*

FORMAT

HOST:FSNAME GWNAME, TYPE, ARGS

/ETC/MTAB – *List of currently mounted filesystems*

Entries ADDED by mount

Entries DELETED by umount

FORMAT – *~~Same as FSTAB~~*
ascii

NFS

NFS

SHOWMOUNT

- Can be used to get a servers exportable file systems

- Can show which file systems have mounted by remote clients

NFS

CONTROLLING ACCESS

- /ETC/EXPORTS

Example

```
/USR
//FORD_PREFECT.       DAVID VAXB SUN1
/JOHN_P/SRC           DAVID
```

NFS

NFS

PERMISSIONS

- UNIX style is expected.

- UID, GID are passed across on each call

- File owner can access file, no matter what permissions are set.

- ROOT is lowest of low (uid = –2)

  *server does this mapping.

- Use of UID/GID implies that list is network wide.

NFS

THINGS TO BE AWARE OF

- NO file locking

- On some systems the '/' directory resides on more than one file system.

- All files are assumed to be unstructured streams of bytes

- All writes go all the way back to the target device, before returning to the user.

NFS

NFS

SOME ADVANTAGES OF THE APOLLO IMPLEMENTATION

- User at a foreign system is able to mount the DOMAIN NETWORK ROOT DIRECTORY.

- No need to re–mount the file system every time you re–boot the node.

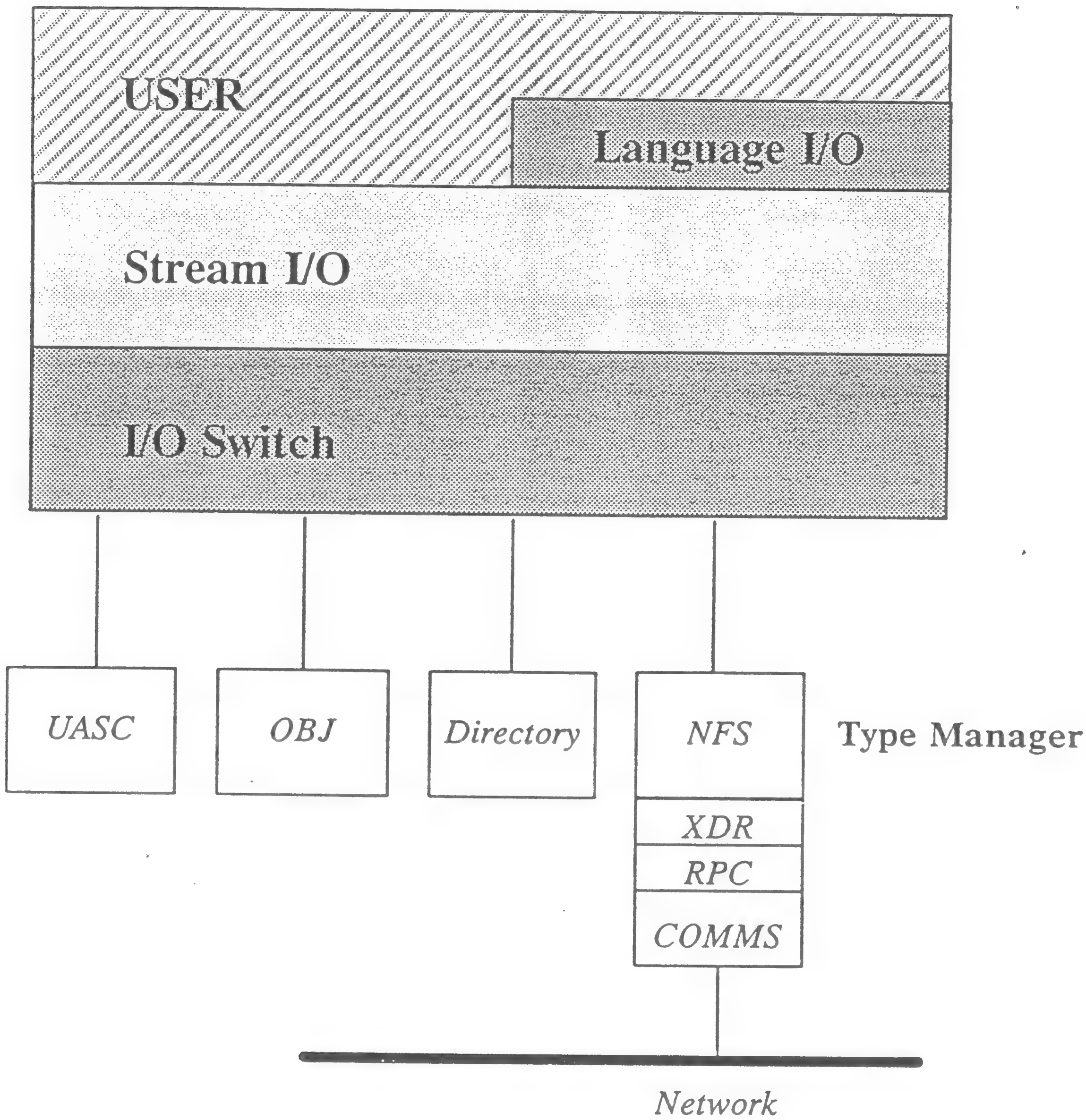
- Objects in the same directory as a mount point still remain accessible.

- Single mount of a foreign file system can make it accessible to all users in the DOMAIN NETWORK.

- Works just as well between Apollo nodes.

NFS

APOLLO IMPLEMENTATIONS



NFS

APOLLO RESTRICTIONS

- Some file types cannot be copied via NFS

- Foreign systems may have problems accessing DOMAIN objects with extended pathnames. (eg casehm files)

- Compilers will not send binary out to an NFS directory

- LD –A does not display access rights to files in mounted directories.

NFS

OTHER COMMANDS

NFSTAT

- Displays various statistics about NFS subsystem

RPCINFO

- Can be used to find out what RPC programs are registered at the remote end.

- Can probe procedure 0 of registered programming to see if they are still alive

NFS

PRE-REQUISITES

- S.R.9.6 or later
- Domain / IX S.R.9.5 or later
- TCP/IP version 3 or later

NFS

STARTING NFS

- Usually best to start it up from the /ETC/RC file.

- TCP_SERVER must be completely up

IF YOU HAVE PROBLEMS

- Check the /sys/node_data/nfs_error_log

  If you get errors trying to mount the remote filesystem use RPCINFO -U

  Is the TCP/IP configured correctly.

NFS

IMPORTANT

The ETC/PASSWD and group files must be network wide.

You cannot assign UID's and GID's in the apollo system

THIS MEANS

> The remote system's passwd and group files must be made to look like those in our /ETC directory.

MODULE 7

X.25

AGENDA

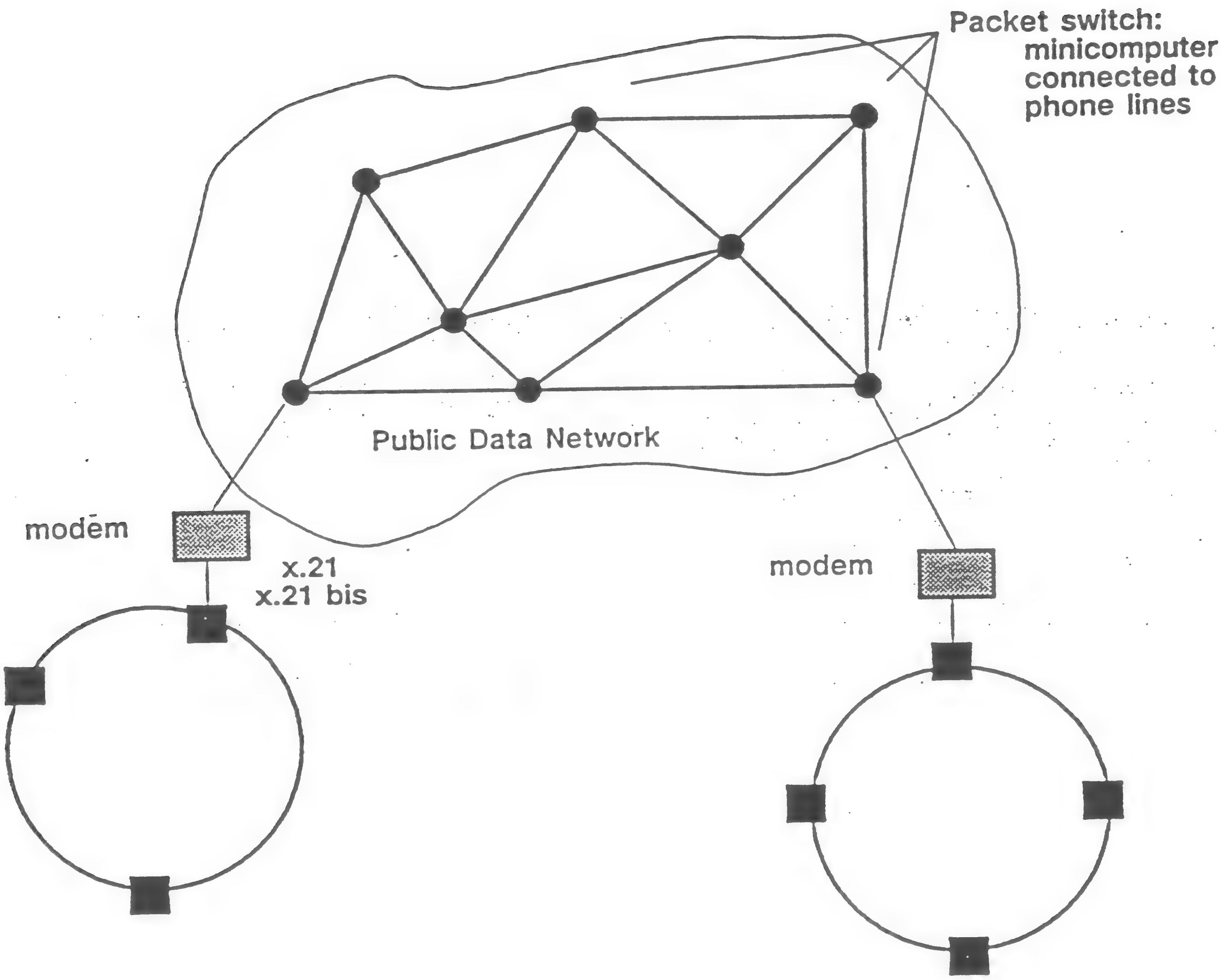
a, INTRODUCTION TO X.25

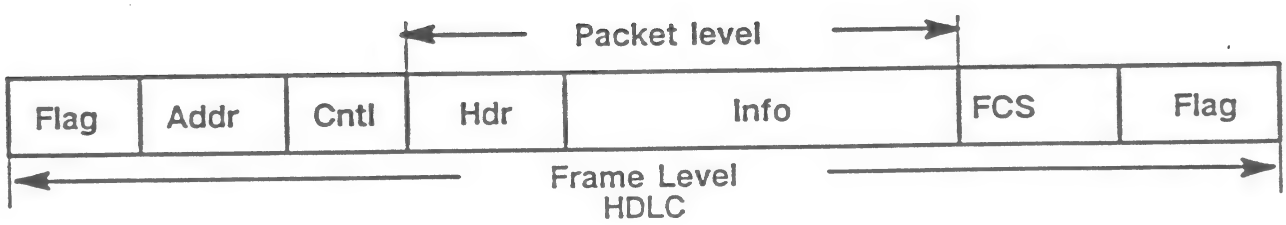
b, CONFIGURATION

c, BRITISH TELECOMM REQUIREMENTS

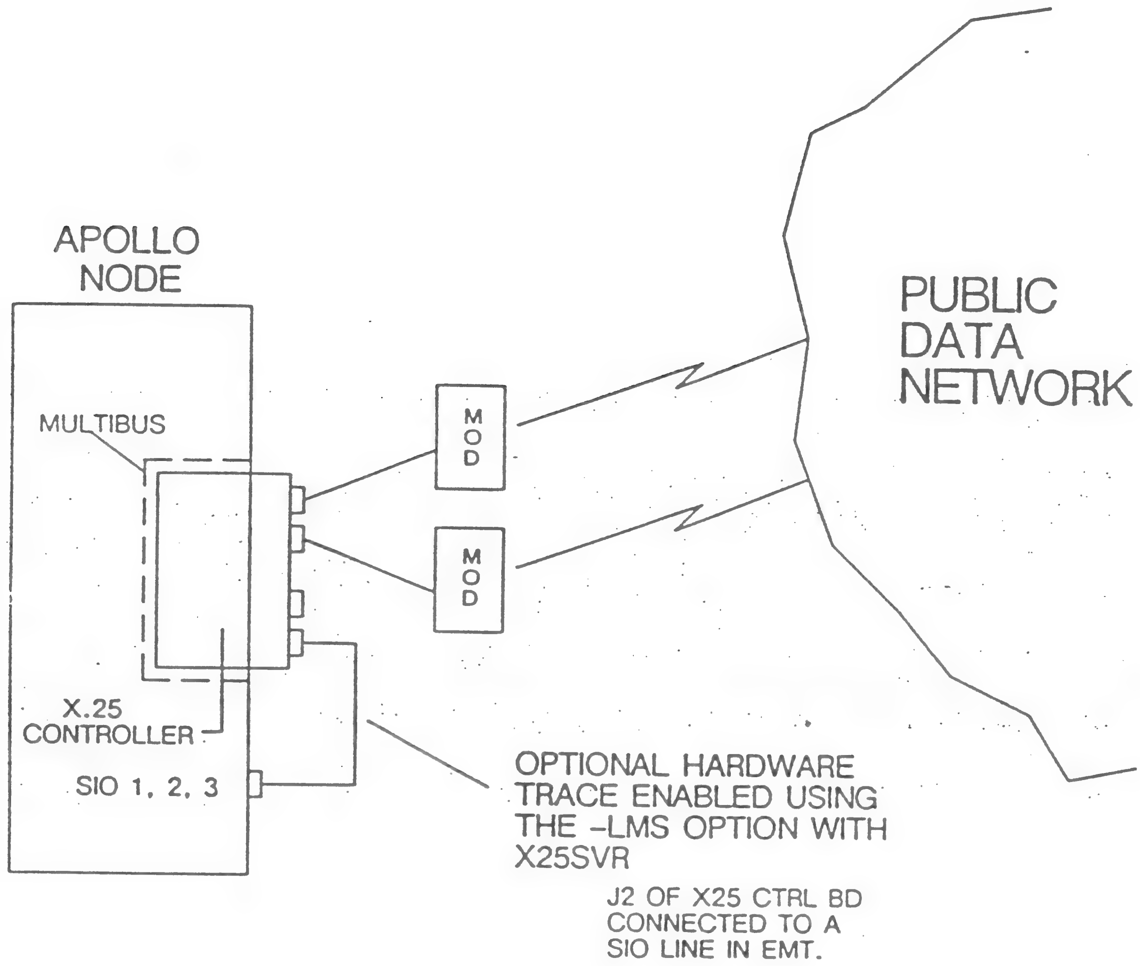
d, SOFTWARE INSTALLATION AND OPERATION

x.25 Packet Switching

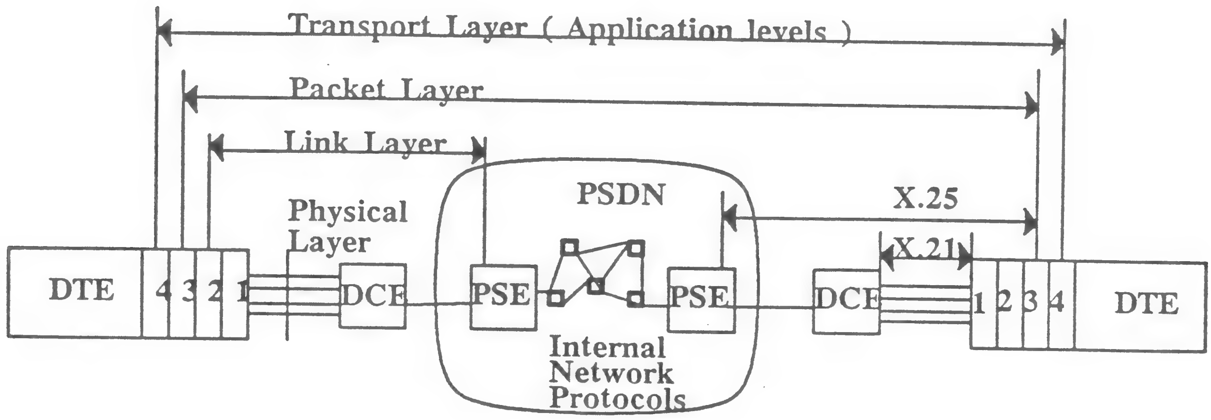


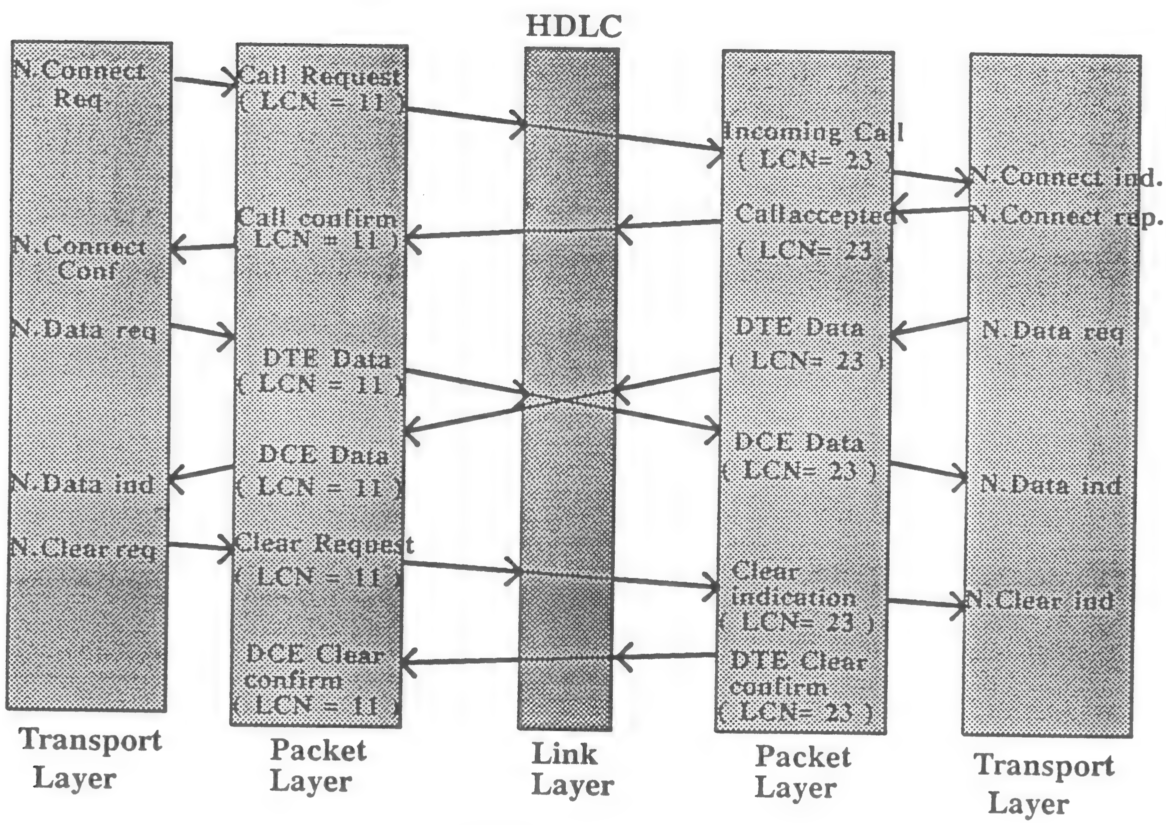


OVERALL PICTURE OF X.25



DETAILED PICTURE OF PSDN (PSS) USAGE





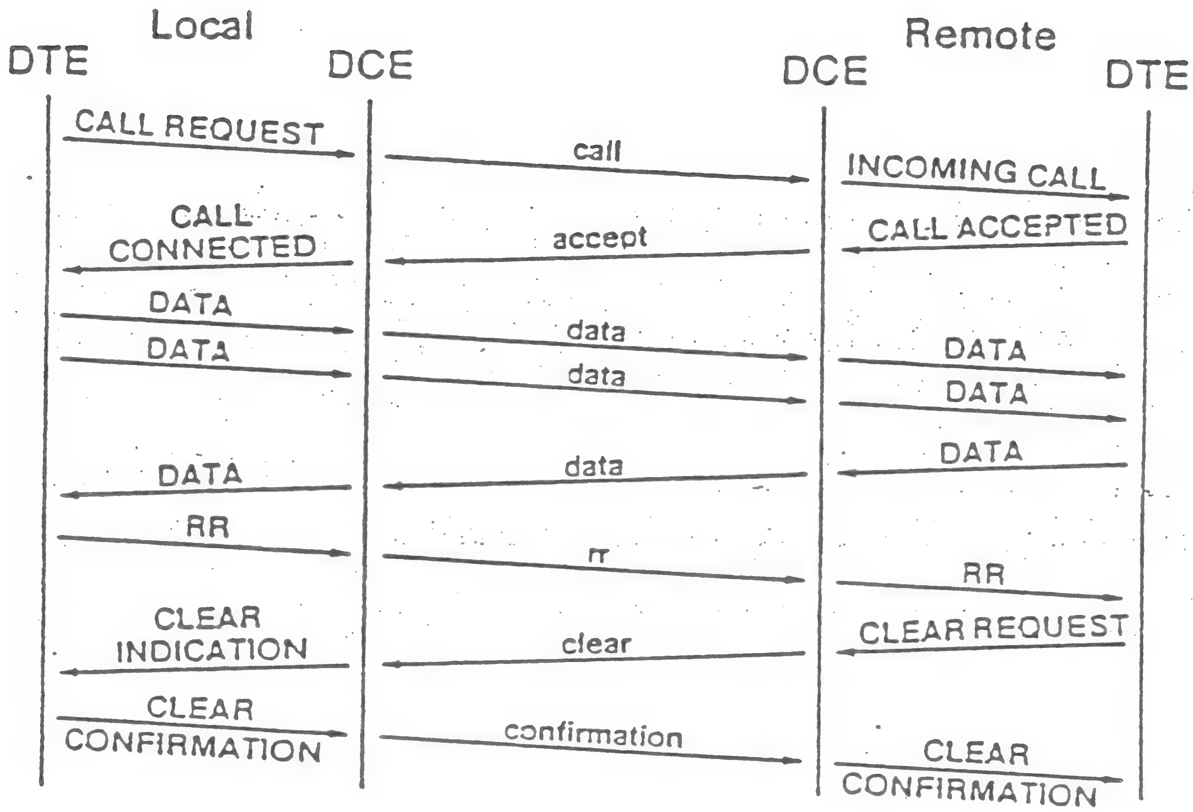
ISO
OSI REFERENCE LAYERS

X.25 PACKET LEVEL

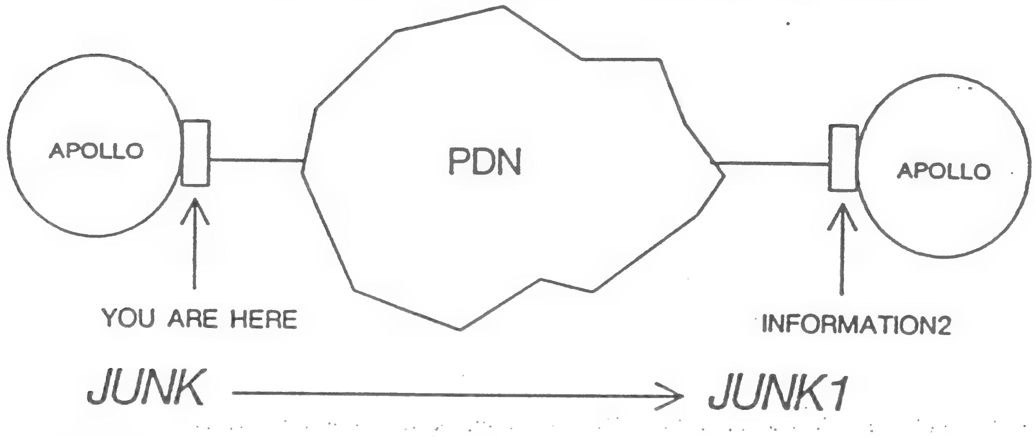
- Call Establishment
- Data Transfer
- Call Clearing
- Restart

14 PACKET TYPE IDENTIFIERS From PAD to EXCHANGE	 From EXCHANGE to PAD	Octet 3 in Packet
	Call Set Up and Clearing	
Call Request	Incoming Call	0 0 0 0 1 0 1 1
Call Accepted	Call Connected	0 0 0 0 1 1 1 1
Clear Request	Clear Indication	0 0 0 1 0 0 1 1
Terminal Clear Confirmation	Exchange Clear Confirmation	0 0 0 1 0 1 1 1
	Data and Interrupt	
Terminal Data	Exchange Data	x x x x x x x 0
Terminal Interrupt	Exchange Interrupt	0 0 1 0 0 0 1 1
Terminal Interrupt Confirm	Exchange Interrupt Confirm	0 0 1 0 0 1 1 1
	Flow Control and Reset	
Terminal RR	Exchange RR	x x x 0 0 0 0 1
Terminal RNR	Exchange RNR	x x x 0 0 1 0 1
Terminal REJ	Exchange REJ	x x x 0 1 0 0 1
Reset Request	Reset Indication	0 0 0 1 1 0 1 1
Terminal Reset Confirmation	Exchange Reset Confirmation	0 0 0 1 1 1 1 1
	Restart	
Restart Request	Restart Indication	1 1 1 1 1 0 1 1
Terminal Restart Confirm	Exchange Restart Confirmation	1 1 1 1 1 1 1 1

EXAMPLE OF A VIRTUAL CALL



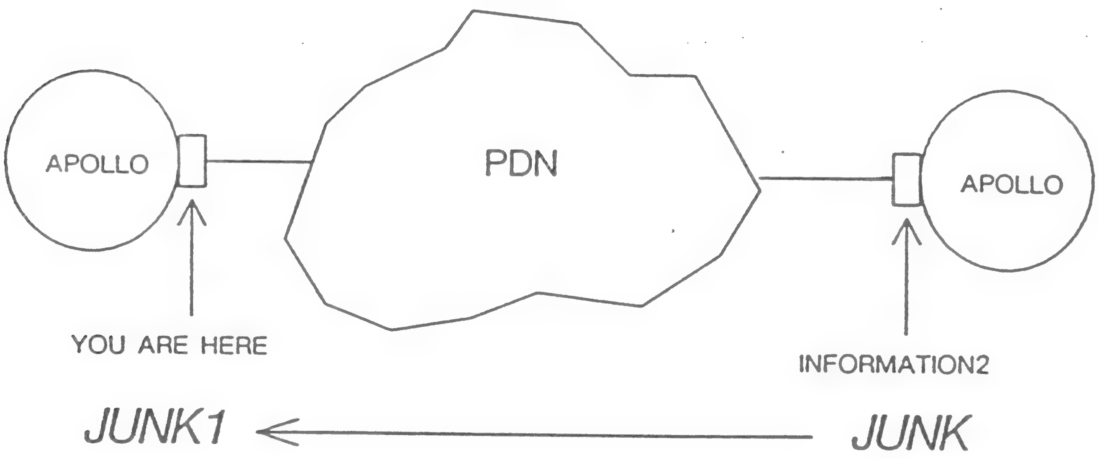
THE CPFX25 COMMAND



$CPFX25 JUNK JUNK1 –DS INFORMATION2<ret>

pathname1 pathname2

The DS option indicates that pathname 1 is local and is to be copied to the remote pathname 2 of the system named information2.



$CPFX25 JUNK JUNK1 –SS INFORMATION2<ret>

pathname1 pathname2

The SS option indicates that pathname 1 on the remote system called information2 is to be copied to pathname2 on the local system.

APPENDIX A

Communications Overview

Over the past several years, the data communications industry has undergone a profound transformation. We have seen the explosion of personal computing, the proliferation of computer networking, and now the advent of true distributed multivendor corporate computing environments. During those same years Apollo Computer Inc. has also evolved, from a proprietary networking architecture to an open environment—supporting open systems, standards, and today's multivendor corporate computing environments. Significantly, Apollo has made this transition without sacrificing the richness of its own original vision of the distributed network environment. Apollo's capabilities and solutions in the communications industry are second to none. To best understand and appreciate Apollo's emergence in this area, this document will explore the basic components which make up today's sophisticated networking environments and then examine Apollo's product set.

The following is a list of topics to be covered. You'll find descriptions of all major industry-standard communications protocols and utilities, along with information on Apollo's implementation of these standards.

The Physical Transport: Local Area Networks

802.3 (Ethernet®)
802.4 (Token Bus for MAP)
802.5 (IBM Token Ring)
Apollo's Token Ring (ATR)
Fiber Distributed Data Interface (FDDI)

The Physical Transport: Wide Area Networks

Integrated System Digital Network (ISDN)
X.25

The Communications Protocols

DECnet™	*LU 6.2*	*OSI*
TCP/IP	*SNA*	*Apollo XNS*

The Applications Protocols

File Transfer
- *FTAM (File Transfer and Management)*
- *FTP (File Transfer Protocol)*
- *IBM 3770*
- *Apollo Copy File and File Transfer Service*

Mail and Messaging
- *UUCP (UNIX®-to-UNIX Copy Program)*
- *DPSS/MAIL™ (Domain Professional Support Services)*
- *X.400*

Virtual Terminal
- *DEC VT100®*
- *General Purpose Virtual Terminal*

Other Applications Protocols

Apollo's Commitment to Standards

Conclusion

Glossary of Apollo Communications Products

The Physical Transport: Local Area Networks

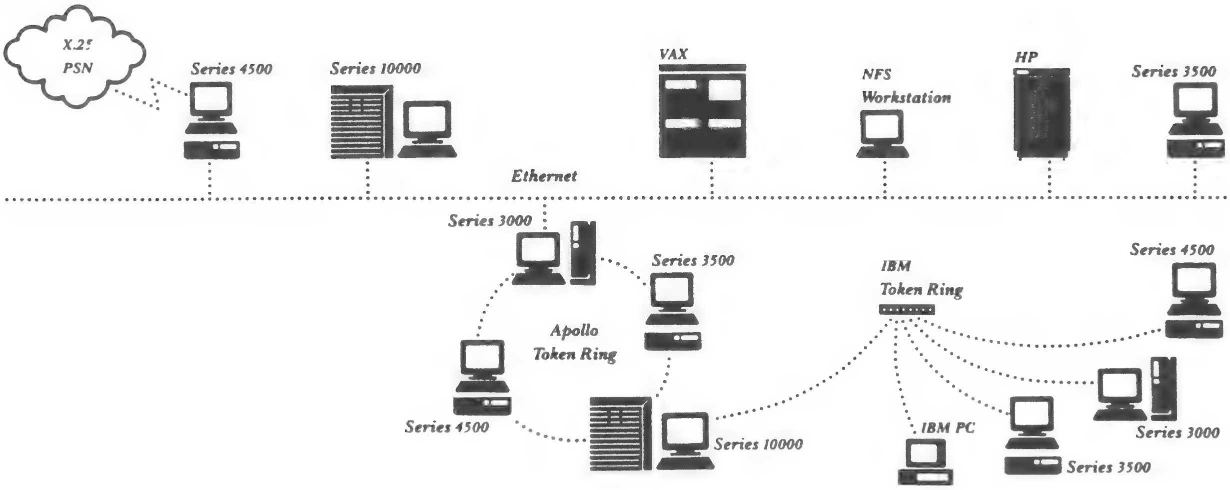
The physical transport is where a network begins. It is the foundation upon which all of the other network components are built and the medium over which all of a network's traffic flows. Depending on a number of factors – including distances, frequency of usage, and number of users – the customer must choose the physical transport that best fits user needs.

The major local area transports or networks today include Apollo's Token Ring, IBM's Token Ring (IEEE 802.5), MAP (IEEE 802.4), Ethernet (IEEE 802.3), and FDDI (Fiber Distributed Digital Interface). Apollo supports them all. More importantly, Apollo provides the ability to transparently tie one or more of these networks together using industry-standard protocols. The following is a brief description of each of the major local area network transports.

802.3 (Ethernet)
Ethernet is an industry-standard, 10Mb-per-second (10Mbps) bus network. Access to an Ethernet network is controlled by a technique called Carrier Sense Multiple Access with Collision Detection (CSMA/CD). This method requires a node to electronically "listen" to the media through a transceiver before transmitting. If no signal is present on the network, the node may transmit data. If a signal is present, the node must wait until the line is clear. Occasionally, two devices may transmit data at the same time, causing the signals to become garbled and a transmission "collision" to occur. In such an event, the two transmitting nodes "back-off" and attempt to retransmit their signals after waiting for a random period of time. Today, Ethernet is the industry's most widely accepted local area network. Its installed base makes up the vast majority of the installed base of LANs. Ethernet was developed in the 1970s by Xerox, Intel, and Digital Equipment Corporation.

Apollo supports Ethernet implementations over all of th major physical media, includin twisted pair, thin wire, broadband, fiber-optics, and standard Ethernet cable. Customers may select Ethernet as the standard primary network controller for any Apollo workstation.

802.4 (Token Bus for MAP)
The token bus access method over broadband or carrierband media is the LAN of choice in manufacturing environments. It is the technology that was chosen by the MAP (Manufacturing Automation Protocol) task force. This LAN media technology (broadband and carrierband) was selected because



Today's Networks

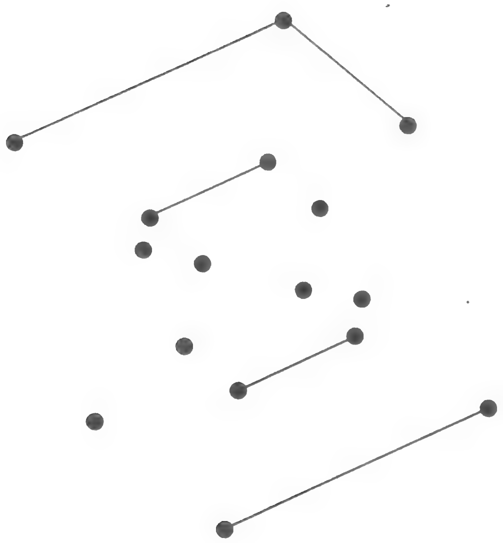
Today's networks comprise three basic components: the *physical transport*, the *communications protocols*, and the *network applications*.

The physical transport is the network or physical media over which data is passed. Examples include Ethernet and token ring local area networks (LANs), X.25 public data networks and switched and leased-line wide area networks (WANs). With these "data pipelines," users can physically link their systems together around the corner, in the next office, or around the world.

The communications protocols, which run above the physical transport, define the rules for communicating over the given transport. These "message handling machines" process the data "envelopes" in much the same way as a post office processes the mail. Data packets are checked for errors and addressing and messages are routed to their final destination. The protocols are responsible for all aspects of message exchange, ranging from reliable transfer to syntax translation and security.

Apollo supports all major protocols, including its own XNS, Digital's DECnet, TCP/IP, IBM's SNA and LU 6.2 and – most significantly – OSI. The communications protocols, in turn, support the many applications that may run over their networks.

At the top of the heirarchy sit the network applications. This software provides the interface tools that the network user actually sees. There are essentially three main functions provided by the network applications: file transfer, electronic mail, and virtual terminal. Apollo supports industry and de facto standard network applications needed to satisfy all three functions in virtually every communications protocol environment.



and gateways to allow the ATR to transparently fit into any industry or de facto standard networking topology. (Apollo utilizes the ATR with Ethernet, IBM Token Ring, X.25, SNA, and others, at its corporate headquarters to support a network of over 3000 nodes.)

In this industry, eight years is a long life for any product. But the Apollo Token Ring has stood the test of time well and will be supported for years to come. In fact, just recently, we even added twisted-pair media as an option for the ATR. Its ability to be integrated into heterogeneous networks makes the ATR a safe choice for workgroup networking of Apollo workstations, IBM personal computers, and other systems.

Fiber Distributed Data Interface (FDDI)

Apollo is playing a key role in developing an FDDI networking standard for bandwidths of 100-200Mbps and will support FDDI with the Series 10000™ Personal Supercomputer™ as the technology for fiber-optic-based networks solidifies. Speeds in the 100Mbps range are crucial to take advantage of the full power of new generation workstations communicating across local area and wide area networks. Apollo will utilize this technology to its fullest following the completion of the FDDI/ANSI standardization efforts.

The Physical Transport: Wide Area Networks

Integrated System Digital Network (ISDN)

ISDN is the future of wide area network transport solutions. It can provide high-speed (dedicated 64Kbps) switched services over public carrier lines. Apollo has demonstrated its ability to transparently link remote Apollo systems using ISDN services and will provide ISDN connectivity in the near future through relationships with strategic solution suppliers.

X.25

The CCITT's X.25 is the bas for internationally standard packet-switched data networks (PSDNs). Although this term means many different things to different people, X.25 is actually a layer-3 (in the OSI reference model) protocol. As such, it is really not a network, but many people will use the services provided by PSDNs as a physical network.

An X.25 PSDN is a cost-effective means for remotely communicating with homogeneous and heterogeneous systems without the expense or

of its inherent electrical properties, which make it practically immune to electrical noise ingress (i.e., static interference) caused by heavy electrical equipment found in the factory environment. The access method (token passing) was selected because of its predictability and deterministic characteristics. In other words, when a manufacturing process is being controlled, it is important that messages are guaranteed to get through in a bounded period of time to keep the process under control (or to keep machinery from crashing into something or someone because a message didn't get through in time).

Apollo supports MAP over h broadband and carrierband media using the IEEE 802.4 token bus access method.

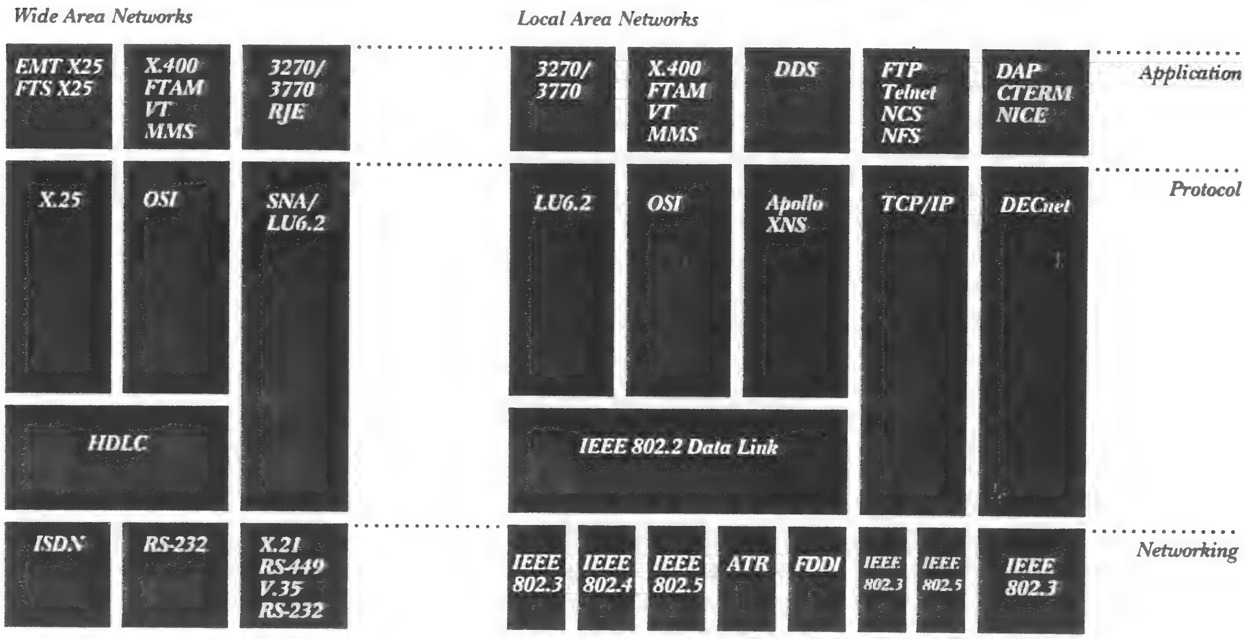
802.5 (IBM Token Ring)
The IEEE 802.5 token ring network is the LAN standard chosen by IBM. This industry-standard 4Mbps token ring network connects as many as 260 devices on a single network. The media used by this standard LAN is shielded or unshielded twisted pair. In other words, instead of requiring bulky coaxial cable throughout the premises, users of 802.5 token ring will be able to make use of the existing telephone wiring as the backbone.

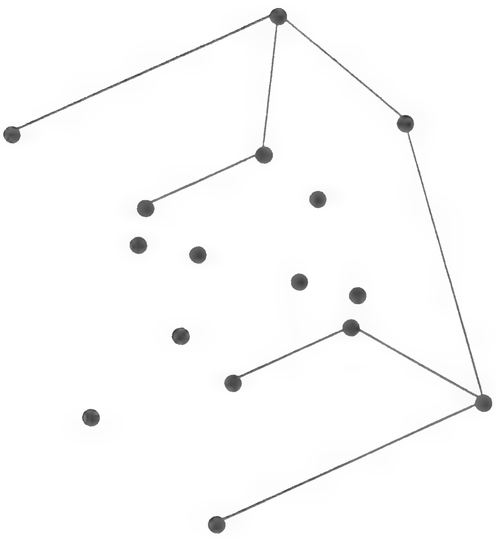
Just as with token bus, access to the IBM Token Ring Network is controlled by a token that is passed from node to node around the network. A node can transmit data only when it has control of the token, so only one transmission takes place at any time. Transmission collisions are avoided, eliminating the inefficiencies of collision detection and data retransmission.

Apollo supports the 4Mbps IEEE 802.5 token ring as one of the standard optional LAN systems included with every workstation sold. The company is committed to support this technology as future improvements are made, such as the planned implementation of IEEE 802.5 operating at 16Mbps.

Apollo Token Ring
Apollo's own networking solution is based on much the same technology used in IEEE 802.5 token ring and IEEE 802.4 token bus. Developed in 1980 (before the IEEE standards existed), the Apollo Token Ring (ATR) is a 12Mbps baseband token-passing ring that, even today, is a technical marvel. The evolution of this product has produced a variety of bridges, routers, switches,

Apollo Protocol Independence





standard UNIX operating systems (Berkeley includes TCP/IP in its source distribution tape, creating some confusion). Apollo supports all of the most current TCP/IP features and includes this protocol as a standard feature of its base operating system (release SR10 or later).

LU 6.2

IBM's Systems Application Architecture (SAA) is based on a peer-to-peer communications protocol called LU 6.2 (Logical Unit Type 6.2). This protocol is a departure from IBM's traditional hierarchical architecture, SNA, which required all messages to be routed through a mainframe before they could be passed to a peer-level system. Apollo's implementation of LU 6.2 allows IBM systems and Apollo systems to communicate as "peers" over a number of physical transports, including Ethernet and IBM Token Ring, as well as dedicated serial lines.

Apollo/LU 6.2 also provides a standard Application Programming Interface (API) that allows applications to be modular and portable from the communications protocols.

SNA

SNA (Systems Networking Architecture) has been IBM's communications protocol since 1974. It is essentially a data link protocol used to link "dumb"

performance restrictions of dedicated leased (telephone) lines.

Apollo's X.25 product provides WAN capabilities to systems ranging from a standalone workstation to a large cluster of LAN-based workstations. With Apollo/X.25, users may remotely log-in to heterogeneous systems or native Apollo systems to execute remote programs, transfer files, or share remote devices.

The Communications Protocols

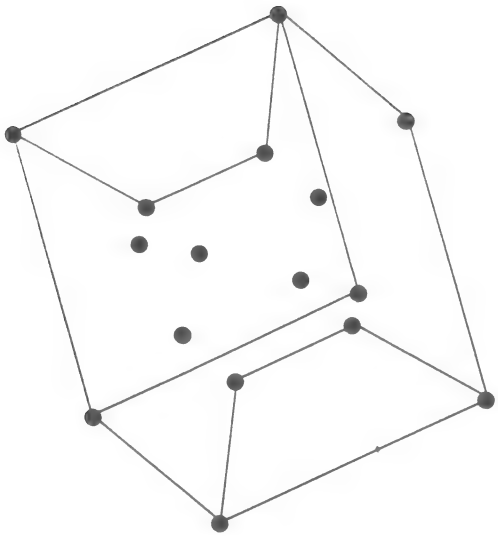
Protocols define the rules for communicating over a given physical transport or network. Although the various networks described above allow for physical connection, they are not much help if the machines on the network do not speak the same language. It would be analogous to an English-speaking person placing a phone call to a German-speaking person. Although the physical telephone-line connection can be made, the two parties cannot understand one another. The same holds true with computers in multivendor environments. Unless they can both converse using a common language (protocol), nothing can be communicated. Accordingly, Apollo supports all of the major industry-standard communications protocols, including LU 6.2 and SNA for talking with IBM, DECnet to talk with DEC, TCP/IP to talk with most any UNIX system, and, of course, the evolving OSI protocols to talk with almost any system in the future.

DECnet

Apollo/TECHnet™ is an implementation of DECnet Phase IV. This protocol allows Apollo workstations to communicate, via Ethernet, with DEC systems for the purpose of bidirectional file transfer, terminal emulation, and process-to-process (task-to-task) communications. Apollo/TECHnet makes the Apollo systems look like native DEC systems to the other DEC systems on the network and is capable of utilizing the DECnet routing capabilities to communicate with remote DECnet systems via X.25.

TCP/IP

Apollo's TCP/IP protocol is the standard means for communicating with heterogeneous systems via Ethernet, Apollo Token Ring or IBM Token Ring, serial lines, and X.25. TCP/IP is considered to be the protocol of choice for UNIX systems, though it really has no formal ties to the



- File transfer, simply the ability to transfer (copy or move) a data file from one computer system to another
- Mail and messaging, the ability to send or receive messages (electronic mail) from one desktop to another
- Virtual terminal, an emulation of the traits of a dissimilar piece of hardware for the purposes of remote log-in and program execution

For each of these three categories, there are various applications that provide the given capability over specific protocols. Apollo supports the vast majority of the major industry-standard applications. Below is a listing of the applications, grouped by category, supported by Apollo over the protocols described above.

File Transfer

DAP (Data Access Protocol)
DAP is the DECnet file transfer protocol. Apollo/TECHnet uses this application to provide bidirectional file transfer between Apollo and DEC VMS® systems in a native DECnet environment.

FTAM (File Transfer and Management)
FTAM is the OSI standard file transfer protocol. Its use is specified in the MAP, TOP, and GOSIP standards. This application protocol is the most complex of all file transfer protocols in that it provides a universal means of translating data syntax and structure as well as performing the copy and move capabilities.

FTP (File Transfer Protocol)
FTP is used with TCP/IP for file transfer. FTP is, in a sense, the predecessor to FTAM, but it is much more simple in nature and provides only the mechanism for moving files, in their original state, from one place to another.

IBM 3770
IBM's 3770 is the mechanism used to pass files through a front-end processor to an IBM mainframe host computer via an SNA network. Apollo supports the emulation of the 3770 controller and can bidirectionally transfer data to and from an IBM environment.

Apollo Copy File and File Transfer Service
Within Apollo's Domain Distributed Services, moving a file from one place to another is as simple as typing *cpf* (copy file). Any file may be transferred from one Apollo system to another via DDS by typing *cpf* (source) (destination). An extension to this service is the Apollo FTS (File Transfer Service) application that runs over Apollo's X.25 network to perform similar services.

terminals and printers via a cluster controller (multiplexor) to a front-end processor (FEP), which in turn is linked to an IBM mainframe computer.

Apollo's SNA makes an Apollo workstation look like a 327X cluster controller or a 377X controller to any IBM front-end processor, providing the link between the terminal/printer environment and the host computer environment. This supports Apollo's SNA 3270 terminal emulation and 3770 file transfer emulation. Using Apollo/SNA, our workstations can act as the terminal, printer, and/or cluster controller, either all from the same workstation or spread around Ethernet, Apollo Token Ring, or IBM Token Ring LAN.

OSI

Apollo's OSI product line is the basis for all future heterogeneous communications. Using OSI, Apollo users are able to communicate with a wide variety of systems via local or wide area networks. The OSI protocols provided by Apollo support all of the major OSI implementations and recommendations, including MAP 3.0 (Manufacturing Automation Protocol), TOP 3.0 (Technical Automation Protocol), U.S. GOSIP (Government OSI Procurement), and U.K. GOSIP. These protocol modules provide all of the necessary components required to send and receive messages through worldwide routing systems as well as administer network management and provide directory services. OSI will be the core of Apollo's communications strategy into the 1990s.

Apollo XNS

In 1980, when Apollo was defining the future of desktop computing in a distributed network, the XNS (Xerox Networking Systems) de facto standard protocol was chosen as the basis for communicating over the Apollo Token Ring LAN. In the absence of any other standards, Apollo's version of XNS has been the protocol used by the Domain® Distributed Services (DDS) applications.

The Apollo XNS is still used to support DDS over Apollo Token Ring—as well as all of the other LANs described above. As Apollo continues to expand its open systems architecture, XNS will be but one of many protocols used to support the DDS applications.

The Applications Protocols

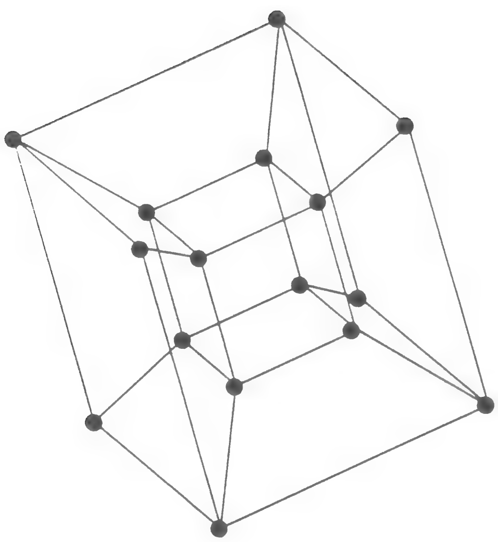
Once a network is chosen and the protocol to run over the network is in place, the only thing left to do is implement the communications applications. In networking, there are basically three classes of communications applications:

TECHnet and X.25 products as user interfaces to their virtual terminal modes.

General Purpose Virtual Terminal
Other terminal emulation packages include Telnet for TCP/IP, EMTX.25 for Apollo/X.25, CTERM virtual terminal for Apollo/TECHnet as well as VT, the OSI standard virtual terminal emulation package for use with the OSI communications protocols. Many other terminal emulation packages are available for the Apollo workstation line through third parties listed in Apollo's application solutions catalogue.

Other Applications Protocols

In addition to the standard three applications – file transfer, mail and messaging, and virtual terminal – Apollo also supports more specialized applications. Examples include Apollo's DDS, the cornerstone for Apollo's distributed file system; Network Computing System™ (NCS), the open distributed computing environment founded by Apollo; and Network File System (NFS™), the de facto standard distributed file system for UNIX systems. In addition, there is the Manufacturing Messaging Service (MMS) application,* defined by MAP, for sending control messages to such factory floor devices as robots, CNC machines, and PLCs.



Apollo's Commitment to Standards

Apollo is strongly committed to openness and has established a record of leadership promoting and delivering industry standards to unify today's multivendor computing environments. Apollo manufactures a broad range of hardware and software – including a complete family of network-based workstations and a full suite of communications, networking, and workgroup computing products. And Apollo has played a major role in various standards bodies, including the Network Computing Forum and the Open Software Foundation.

Conclusion

Apollo is the technology leader in the workstation marketplace and now has emerged as the communications leader. Its workstations have been ported to every major network environment, giving its customers the flexibility to utilize the superior technology that Apollo workstations offer without sacrificing the advantages of today's multivendor networks. With these enhancements, Apollo has positioned itself to be a major force in the computer industry for many years to come.

Mail and Messaging

UUCP (UNIX-to-UNIX Copy Program)
UUCP is a de facto industry standard that provides simple message passing between UNIX systems. Although commonly used with TCP/IP, it is not a true TCP/IP application. Apollo supports UUCP as a standard utility of its operating system.

DPSS/MAIL (Domain Professional Support Services)
Apollo's native mail system is DPSS/MAIL. This service is available as a means to exchange messages among Apollo users via any DDS networked environment. Use of this product in conjunction with UUCP or X.400 is possible since Apollo provides "gateway" functionality in both directions.

X.400
X.400 is the CCITT standard that has been accepted by OSI as the universal mail and messaging service for all levels of computing equipment. This application is also a major component of the GOSIP and TOP requirements. The primary function of X.400 is to provide reliable delivery and distribution of electronic-mail messages to heterogeneous computer systems. The service provides for delivery and verification of delivery of electronic-mail messages only. The content of the message is not in any way affected by the X.400 application protocol.

Apollo provides X.400 services for its products in the form of a Message Transfer Agent (MTA) gateway and a User Agent (UA) interface for each individual user. Apollo's X.400 is capable of supporting UUCP and DPSS/MAIL via X.400 services for heterogeneous communications.

Virtual Terminal

IBM 3270, 3192G, 5080
Apollo supports emulation of many of the popular IBM terminal models as well as emulation of the cluster controllers and host interfaces required to link to the IBM computing environment. Many of the traditional IBM terminal features are greatly enhanced through their execution on Apollo workstations since multiple sessions may be displayed on a single workstation through the use of multiple windows.

DEC VT100
Support of Digital Equipment Corporation's popular VT100 terminal emulation is a standard feature of the Apollo operating system's utilities. VT100 emulation has also been incorporated in the Apollo/

Glossary of Apollo Communications Products

Apollo/SNA and Apollo Com/ Controller–this group of products provides connectivity for Apollo networks to certain IBM SNA computers.
Apollo/SNA-3270–this SNA product allows Apollo workstations to emulate any mix of IBM 3278 Model 2, Model 3, Model 4, or Model 5 terminals, 3279 4-color terminals and 3287 printers.
Apollo 5080 Emulator–the 5080 Emulator allows Apollo's network users to emulate IBM's 5080-based graphics and to access mainframe-based applications.
Apollo/Access–allows workstation users to obtain transparent file access to Digital Equipment Corporation's VAX®/VMS system.
Etherbridge–allows Apollo Token Ring Networks to be connected via industry-standard Ethernet.
Apollo/X.25–provides Apollo workstations with the ability to communicate over packet-switched wide area networks (WAN).
Apollo /LU 6.2–a Systems Network Architecture (SNA) communications product that extends Apollo's networking capability to include IBM's Advanced Program-to-Program Communications (APPC) standard, LU 6.2 and PU 2.1.
Apollo/X.400–allows mail messages to be exchanged between personal computers, minicomputers, workstations, mainframes, and supercomputers from a wide variety of vendors.
Apollo/TECHnet–allows up to 255 bidirectional virtual terminal sessions between Apollo and DEC VMS or Ultrix® DECnet Phase-IV systems. Users of Apollo/TECHnet can 'sethost' to DEC systems, and DEC users can 'set host' to Apollo workstations running Apollo/TECHnet.
Apollo TCP/IP–provides Apollo workstation users with shared access to heterogeneous systems, including mainframes, superminicomputers, personal computers, and other workstations.
IBM Token Ring–the 4Mbps IBM Token Ring is one of the many communication media available for linking Apollo systems in a local area network. This IEEE standard LAN operates over unshielded twisted-pair cable and is capable of supporting Apollo's Distributed Services, TCP/IP, OSI and LU 6.2.
Channel Connect-AT–provides IBM channel communications for an Apollo network running SNA or 5080.
Apollo Token Ring–the Apollo Token Ring operates at 12Mbps and supports Apollo's Distributed Services, TCP/IP, OSI, and LU 6.2. The ATR is one of the optional LANs available to the Apollo workstations.
Serial Controller-AT–an AT® bus-compatible communications controller, the Serial Controller-AT provides wide area communications to Apollo networks for SNA and X.25 applications.
Ethernet–industry-standard 10Mbps Ethernet is available for all Apollo workstations for providing interoperation between Apollo workstations and other vendors' systems. Using Ethernet running over a wide variety of media, Apollo systems may communicate via DDS, TCP/IP, OSI, or LU 6.2.

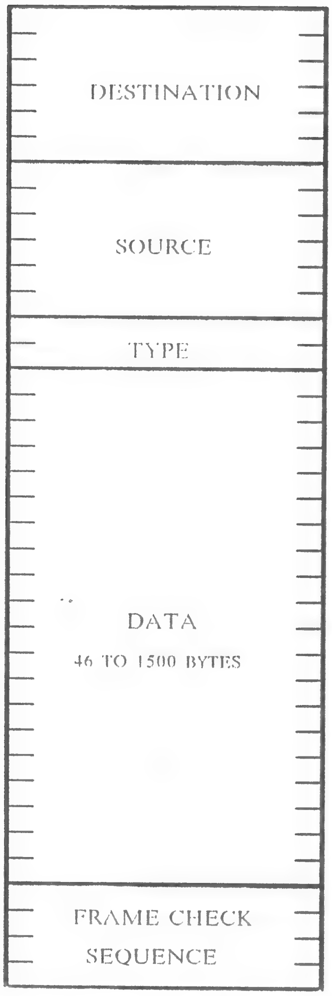
CTRL-	CODE	HEX	DEC	CODE	HEX	DEC	CODE	HEX	DEC	CODE	HEX	DEC
@	NUL	00	0	SP	20	32	@	40	64	`	60	96
A	SOH	01	1	!	21	33	A	41	65	a	61	97
B	STX	02	2	"	22	34	B	42	66	b	62	98
C	ETX	03	3	#	23	35	C	43	67	c	63	99
D	EOT	04	4	$	24	36	D	44	68	d	64	100
E	ENQ	05	5	%	25	37	E	45	69	e	65	101
F	ACK	06	6	&	26	38	F	46	70	f	66	102
G	BEL	07	7	'	27	39	G	47	71	g	67	103
H	BS	08	8	(	28	40	H	48	72	h	68	104
I	HT	09	9	)	29	41	I	49	73	i	69	105
J	LF	0A	10	*	2A	42	J	4A	74	j	6A	106
K	VT	0B	11	+	2B	43	K	4B	75	k	6B	107
L	FF	0C	12	,	2C	44	L	4C	76	l	6C	108
M	CR	0D	13	-	2D	45	M	4D	77	m	6D	109
N	SO	0E	14	.	2E	46	N	4E	78	n	6E	110
O	SI	0F	15	/	2F	47	O	4F	79	o	6F	111
P	DLE	10	16	0	30	48	P	50	80	p	70	112
Q	DC1	11	17	1	31	49	Q	51	81	q	71	113
R	DC2	12	18	2	32	50	R	52	82	r	72	114
S	DC3	13	19	3	33	51	S	53	83	s	73	115
T	DC4	14	20	4	34	52	T	54	84	t	74	116
U	NAK	15	21	5	35	53	U	55	85	u	75	117
V	SYN	16	22	6	36	54	V	56	86	v	76	118
W	ETB	17	23	7	37	55	W	57	87	w	77	119
X	CAN	18	24	8	38	56	X	58	88	x	78	120
Y	EM	19	25	9	39	57	Y	59	89	Y	79	121
Z	SUB	1A	26	:	3A	58	Z	5A	90	z	7A	122
[	ESC	1B	27	;	3B	59	[	5B	91	{	7B	123
\	FS	1C	28	<	3C	60	\	5C	92	¦	7C	124
]	GS	1D	29	=	3D	61	]	5D	93	}	7D	125
CTRL	RS	1E	30	>	3E	62	CTRL	5E	94	~	7E	126
—	US	1F	31	?	3F	63	—	5F	95	DEL	7F	127

NUL Null, or all zeros
SOH Start of Heading
STX Start of text
ETX End of Text
EOT End of transmission
ACK Acknowledge
BEL Bell or Alarm
BS Backspace
HT Horizontal Tab
VT Vertical Tab
CR Carriage Return
NAK Negative Acknowledge
ETB End Transmission Block

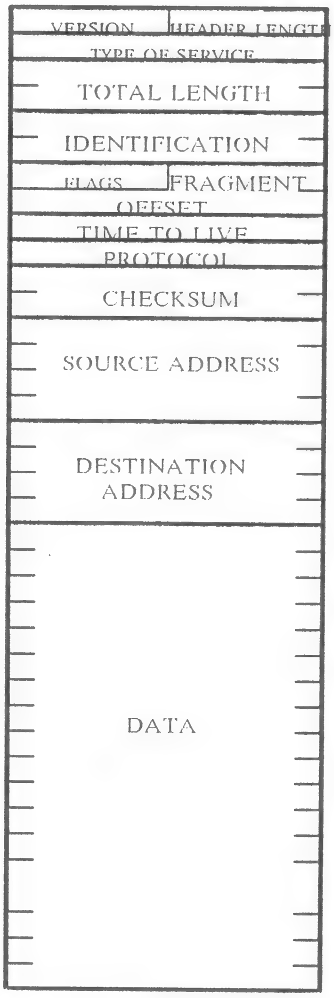
DC1 Device Control 1
DC2 Device Control 2
DC3 Device Control 3
DC4 Device Control 4
CAN Cancel
EM End of Medium
SUB Substitute
FS File Separator
GS Group Separator
RS Record Separator
US Unit Separator
SP Space
DEL Delete

SI Shift In
SO Shift Out
SYN Sync.
LF Line Feed
FF Form Feed
ENO Enquiry
ESC Escape
DLE Data Link Escape

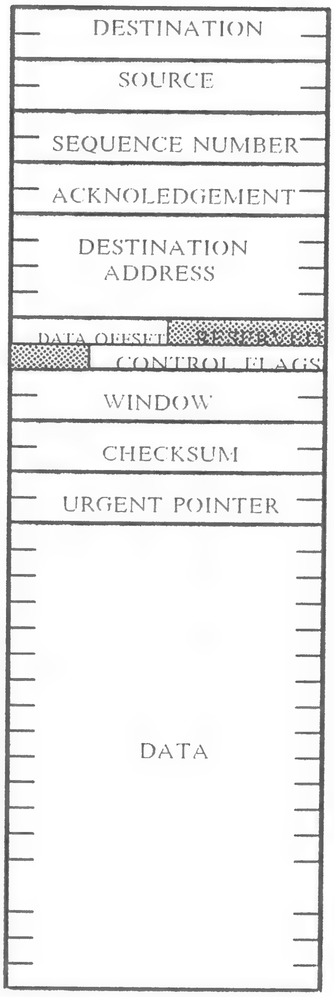
PROTOCOL HEADERS



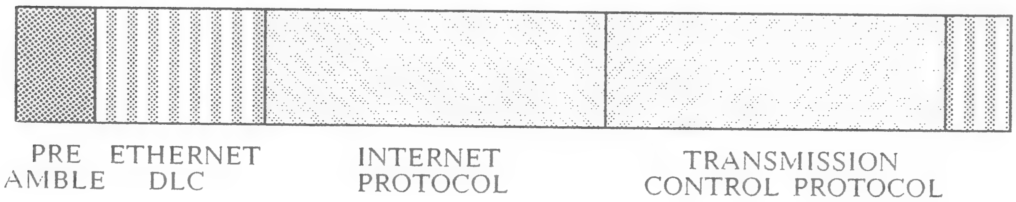
DATA LINK LAYER
FRAME FORMAT
FOR ETERNET.



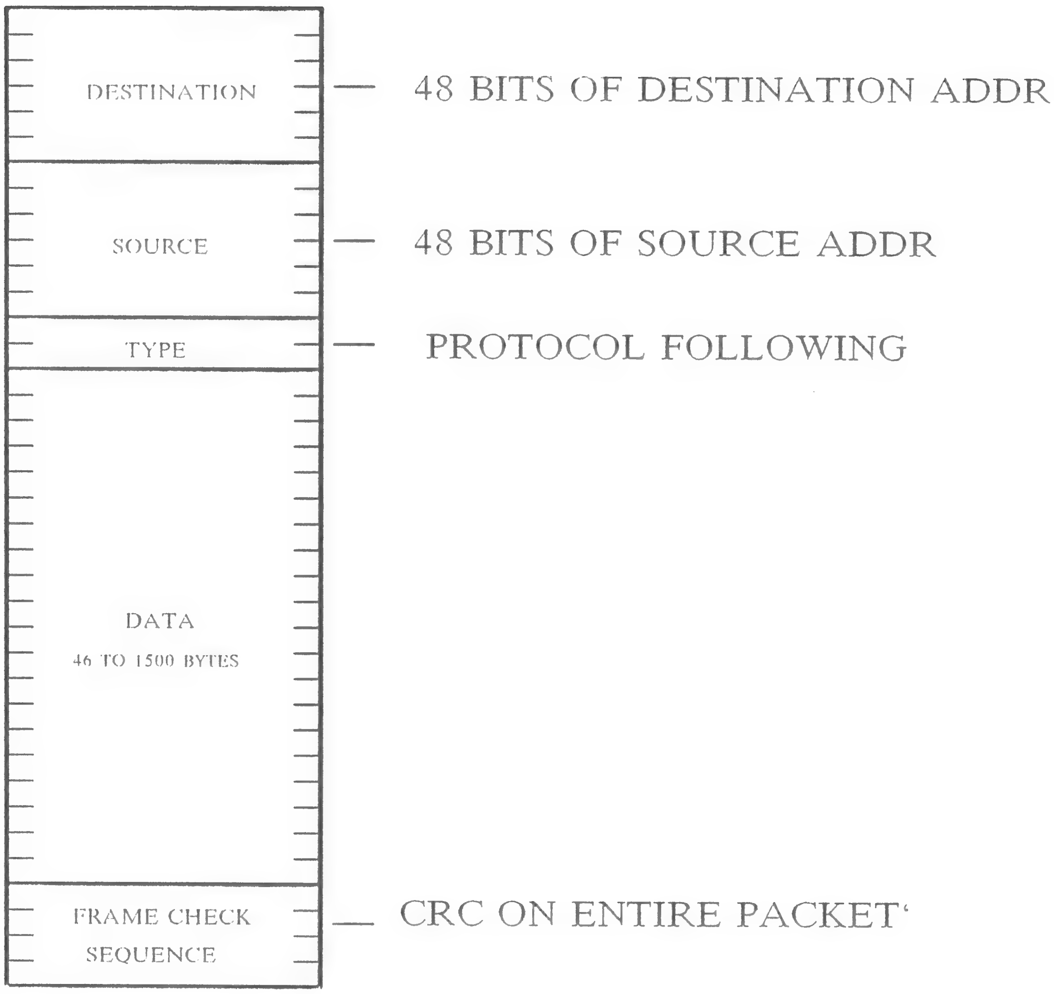
INTERNET
PROTOCOL
FRAME FORMAT



TRANSMISSION
CONTROL
PROTOCOL
HEADER

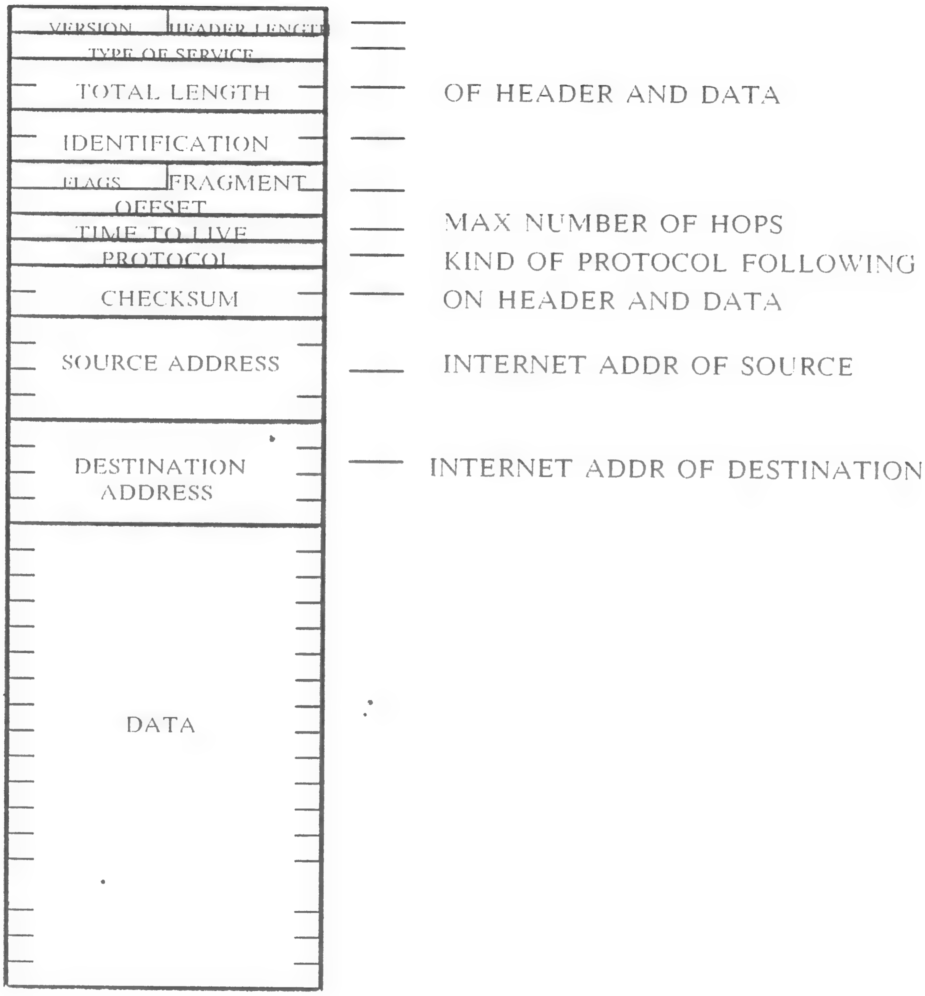


ETHERNET HEADER



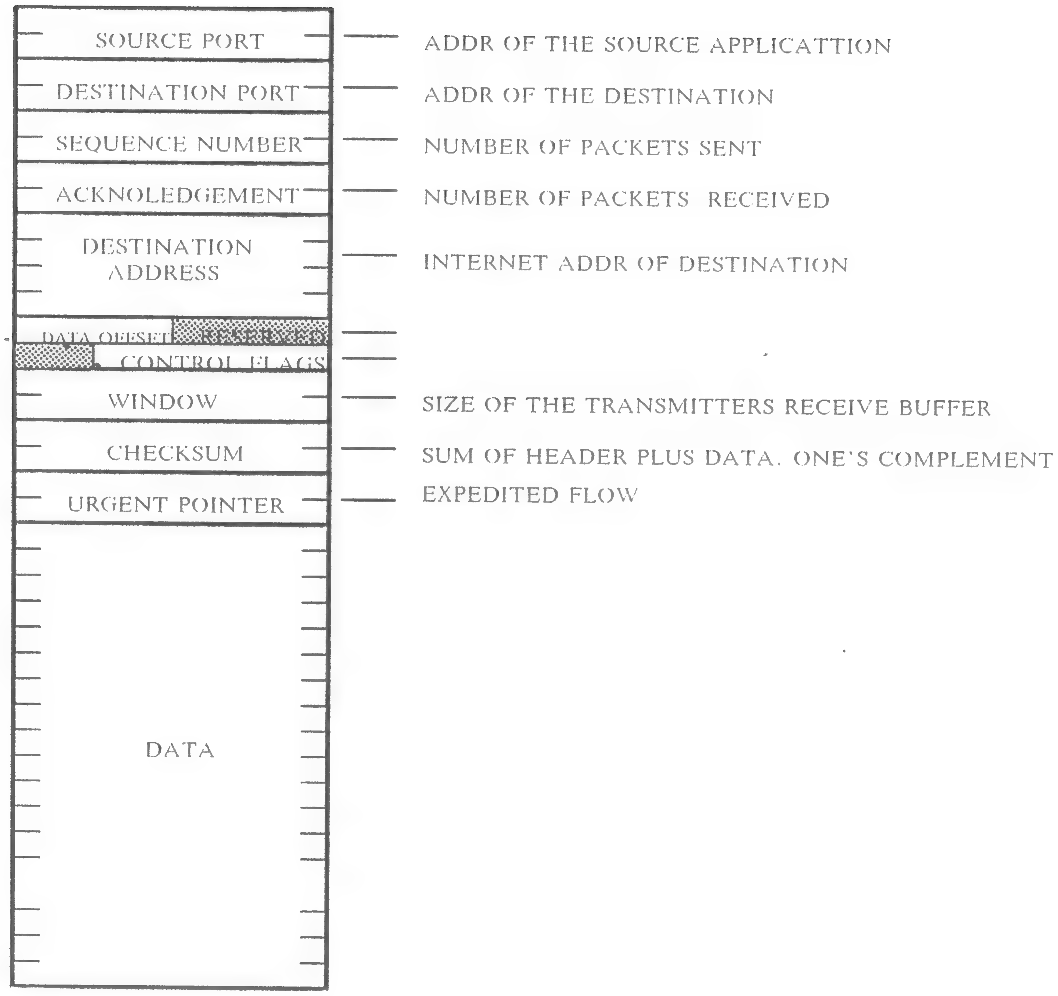
DATA LINK LAYER
FRAME FORMAT
FOR ETERNET.

IP HEADER



INTERNET PROTOCOL FRAME FORMAT

TCP HEADER



TRANSMISSION CONTROL PROTOCOL HEADER

APPENDIX B

BSD 4.2 TCP/IP Software Load and Configuration Lab Procedures (Non–ARPANET)

1. Load BSD 4.2 TCP/IP Ver 3.1 software.

2. On Admin node, configure /etc/hosts file to contain all accessable hosts. Configure this file with the following format: **INTERNET ADDRESS HOST NAME**

3. On Admin node, configure /etc/networks file to contain all accessable networks. Configure this file with the following format: **NETWORK NAME NETWORK ADDRESS**

4. On Admin node, configure /etc/gateways file with any non–RIP Gateway. This procedure is not required when using Apollo nodes as gateways. See Configuring and Managing TCP/IP.

5. Create links to the above files from each host and gateway in the Admin nodes network. If these nodes have the /etc/hosts, /etc/networks, and /etc/gateways files, delete them and create links to the Admin nodes /etc/hosts, /etc/networks, and /etc/gateways files. If the node uses a link to a Unix environment, then the above mentioned links are already in place. All you need to do is edit the /etc/hosts, /etc/networks, and /etc/gateways (if necessary) files on the Unix admin node.

The rest of these steps are to be performed on every Apollo node running TCP/IP.

6. Edit the /sys/node_data.(node_id)/startup.(device) files and uncomment the **cps /etc/run_rc** line on each host and gateway.

7. Log in as "**root**" and edit the /sys/node_data.(node_id)/etc.rc file of each TCP/IP node. There are separate steps for gateways and hosts, each are given below:

For hosts, add the following lines to the etc.rc file without skipping any lines. (Empty lines may cause errors when reading this file.)

```
if [ -f /sys/tcp/tcp_server ]; then
  /sys/tcp/tcp_server
fi
if [ -f /etc/routed ]; then     (this may already be in the etc.rc file, however you must add
  /etc/routed -h                 -h switch to the routed.)
fi
```

Uncommment the inet daemon.

```
if [ -f /etc/inetd ]; then
  /etc/inetd
fi
```

BSD 4.2 TCP/IP Software Load and Configuration Lab Procedures (Non-ARPANET)

For gateways, add the following lines to the etc.rc file:

if [-f /sys/tcp/tcp_server]; then
 /sys/tcp/tcp_server -n
fi
if [-f /sys/tcp/tcpinit]; then
 /sys/tcp/tcpinit
fi
if [-f /etc/routed]; then (this may already be in the etc.rc file, however you must add
 /etc/routed -h switch to the **routed**.)
fi

Uncomment the inet daemon.

if [-f /etc/inetd]; then
 /etc/inetd
fi

8. Change ownership of the **etc.rc** file to **root ownership** with the following command:
/etc/chown root etc.rc

9. Give access rights to the **etc.rc** file strictly to **root** with the following command:
chmod 4755 etc.rc

10. Edit the /sys/node_data.(node_id)/etc.inetd.conf file and make sure that the telnet and ftp daemons are uncommented.

11. Edit the /sys/node_data.(node_id)/thishost file and add the IP hostname of this node.

12. Edit the /sys/node_data.(node_id)/networks file and add the Internet to Physical Address information for this node. Example for a host on Apollo Token Ring Network
100.0.0.2 on dr0.
Example for gateway node on ATR and Ethernet –
100.0.0.3 on dr0
200.0.1.1 on eth0

13. Create and /etc/hosts.equiv file and place any hosts on your network that can access this host without password verification. See Managing and Configuring TCP/IP Manual.

14. Reboot each node (Phase II boot shell will suffice) and execute Telnet and FTP commands. Can you telnet and ftp to each node in the lab?

15. See Release Notes. Execute /etc/ping with options and netstat commands.

End of Lab

BSD 4.2 TCP/IP Ver. 3.1 Load And Configuration Lab Procedures (ARPANET)

1. Load BSD 4.2 TCP/IP Ver 3.1 software.

2. On Admin node, configure **/etc/localhosts** file to contain all accessable hosts in your local networks. Configure this file with the following format:
INTERNET ADDRESS   HOST NAME

3. On Admin node, configure **/etc/localnetworks** file to contain all locally accessable networks. Configure this file with the following format:
NETWORK NAME   NETWORK ADDRESS

4. On Admin node, configure **/etc/localgateways** file with any local non-RIP Gateway. This procedure is not required when using Apollo nodes as gateways. See Configuring and Managing TCP/IP for format of file (use /etc/gateways example).

5. On Admin node, create a **/etc/hosts.txt** file and place two carraige returns within the file. This file will be identical to the /sys/tcp/hostmap/hosts.txt file used in AEGIS which contained all the accessable ARPANET networks, gateways and hosts. But as in the AEGIS TCP/IP, we initially use a blank hosts.txt file for local network verification first. After you have verified that your local configuration works you would run the **/etc/gettable** program to retrieve the actual /etc/hosts.txt file from the ARPANET's Standford Research Institute Network Information Center (SRI-NIC). The Release Notes (page 3-12) explain this procedure. However, within this lab, you only use the manually created /etc/hosts.txt file.

6. On Admin node, run the **/etc/htable** program which merges the /etc/hosts.txt file with the /etc/localhosts, /etc/localnetworks, and /etc/localgateways files to create the /etc/hosts, /etc/networks, and /etc/gateways files containing all accessable networks, gateways, and hosts.

The rest of these steps are to be performed on every Apollo node running TCP/IP.

7. Create links to the above files from each host and gateway in the Admin nodes network. If these nodes have the /etc/hosts, /etc/networks, and /etc/gateways files, delete them and create links to the Admin nodes /etc/hosts, /etc/networks, and /etc/gateways files. If the node uses a link to a Unix environment, then the above mentioned links are already in place. All you need to do is edit the /etc/hosts, /etc/networks, and /etc/gateways (if necessary) files on the Unix admin node.

6. Edit the /sys/node_data.(node_id)/startup.(device) files and uncomment the **cps /etc/run_rc** line on each host and gateway.7. Log in as "**root**" and edit the /sys/node_data.(node_id)/etc.rc file of each TCP/IP node. There are separate steps for gateways and hosts, each are given below:**For hosts**, add the following lines to the etc.rc file without skipping any lines. (Empty lines may cause errors when reading this file.)

if [-f /sys/tcp/tcp_server]; then

/sys/tcp/tcp_server
fi
if [-f /etc/routed]; then (this may already be in the etc.rc file, however you must add
/etc/routed -h -h switch to the **routed**.)
fiUncomment the inet daemon.
if [-f /etc/inetd]; then
/etc/inetd
fiFor gateways, add the following lines to the etc.rc file:
if [-f /sys/tcp/tcp_server]; then
/sys/tcp/tcp_server -n
fi
if [-f /sys/tcp/tcpinit]; then
/sys/tcp/tcpinit
fi
if [-f /etc/routed]; then (this may already be in the etc.rc file, however you must add
/etc/routed -h switch to the **routed**.)
fi
Uncomment the inet daemon.
if [-f /etc/inetd]; then
/etc/inetd
fi8. Change ownership of the **etc.rc** file to **root ownership** with the following command: **/etc/chown root etc.rc**9. Give access rights to the **etc.rc** file strictly to **root** with the following command:
chmod 4755 etc.rc10. Edit the /sys/node_data.(node_id)/etc.inetd.conf file and make sure that the telnet and ftp daemons are uncommented.

11. Edit the /sys/node_data.(node_id)/thishost file and add the IP hostname of this node.12. Edit the /sys/node_data.(node_id)/networks file and add the Internet to Physical Address information for this node. Example for a host on Apollo Token Ring Network

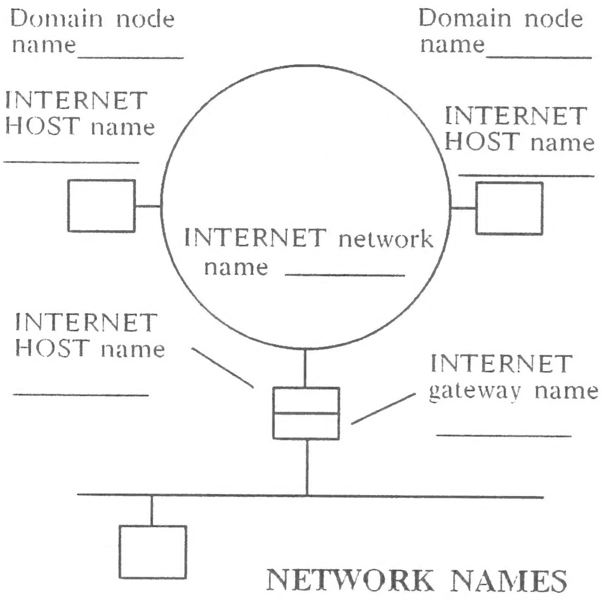
100.0.0.2 on dr0.
Example for gateway node on ATR and Ethernet -
100.0.0.3 on dr0
200.0.1.1 on eth0

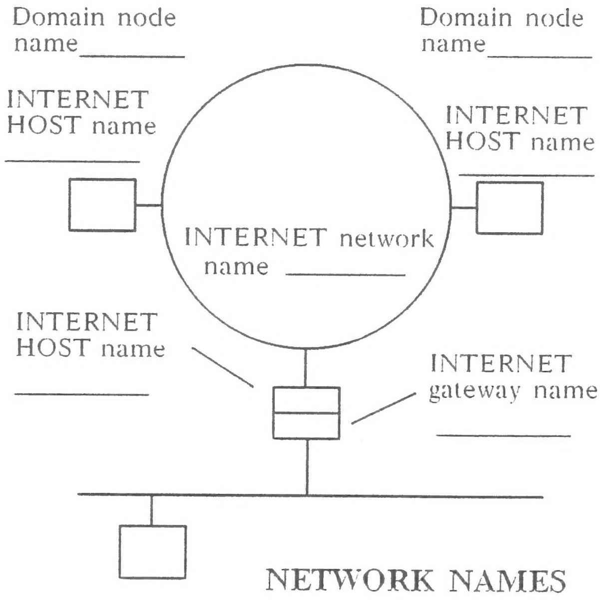
13. Reboot each node (Phase II boot shell will suffice) and execute Telnet and FTP commands. Can you telnet and ftp to each node in the lab?

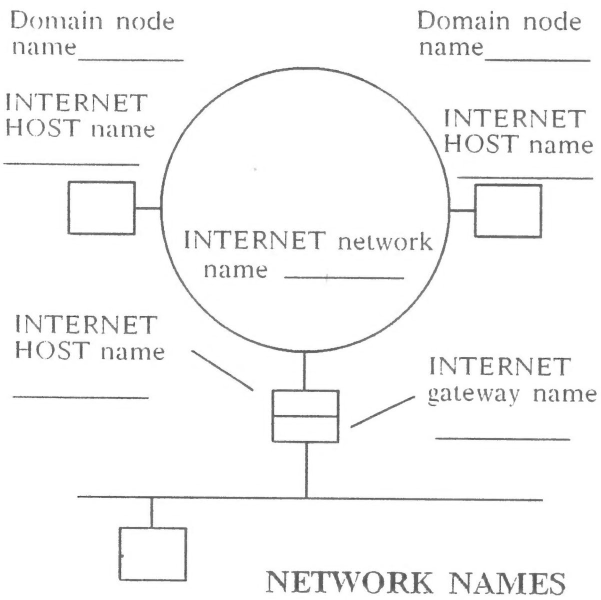
14. See Release Notes. Execute /etc/ping with options and netstat commands.
End of Lab

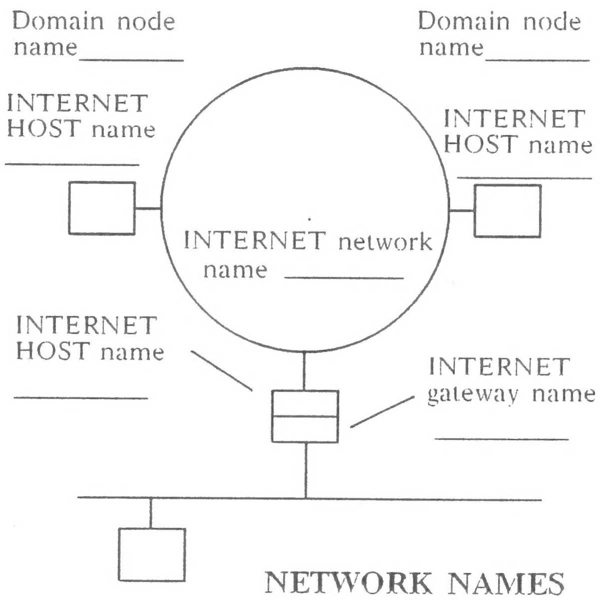
APPENDIX C

TCP/IP WORK MAP

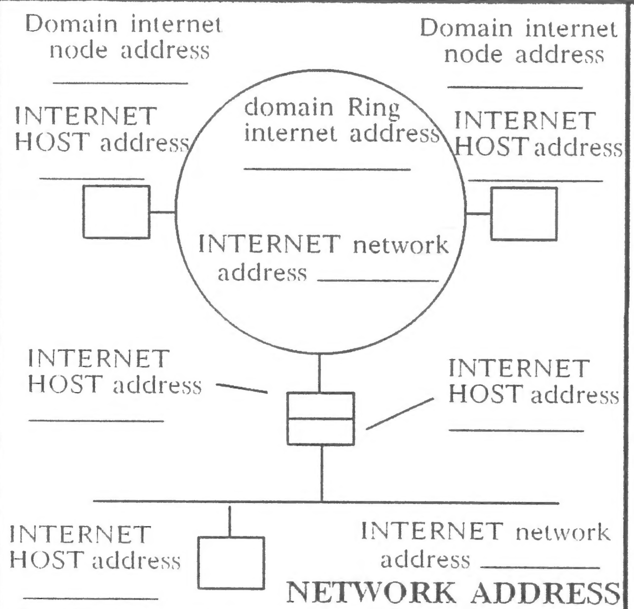








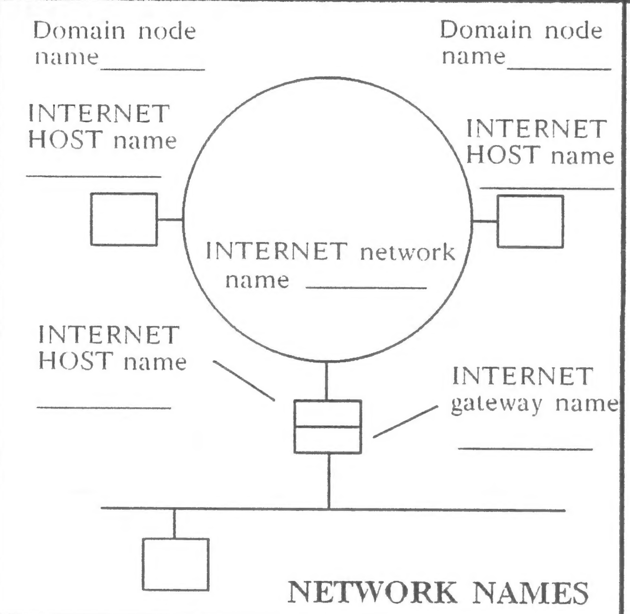
TCP/IP WORK MAP



NETWORK ADDRESS

no.	node-id	node type	Function: G = gtwy C = client A = admin
N1			
N2			
N3			
N4			
N5			
N6			
N7			
N8			
N9			
N10			
N11			
N12			
N13			
N14			
N15			
N16			
N17			
N18			
N19			
N20			

NODE LIST



NETWORK NAMES

//node_id/sys/tcp/thishost

spanky

ALL HOSTS

//node_id/sys/tcp/networks

197.9.8.3 on dr0

CLIENT

//node_id/sys/tcp/networks

197.9.8.3 on dr0
135..3.3.2 on il0

GATEWAY

//Admin_node/sys/tcp/hostmap/local.txt

```
NET: 197.9.8.0 : ANET :
NET: 135.3.3.0 : BNET:
GATEWAY : 197.9.8.3 , 135.3.3.2 : GWAY :
HOST : 197.9.8.3 : SPANKY :
HOST : 135.3.3.3 : MR_VAX :
```

EXAMPLES

NET Entries

Net-addr	Net Names

GATEWAY Entries

Addr1	addr2	name	cputype	opsys	protocol

HOST Entries

Addr, alt-addr	Names	Cpu	Opsys	Protocol

WORKSHEET FOR LOCAL.TXT

TCP/IP WORK MAP